JUNE 27, 1960

Published every-other-Monday

Seventy-five cents

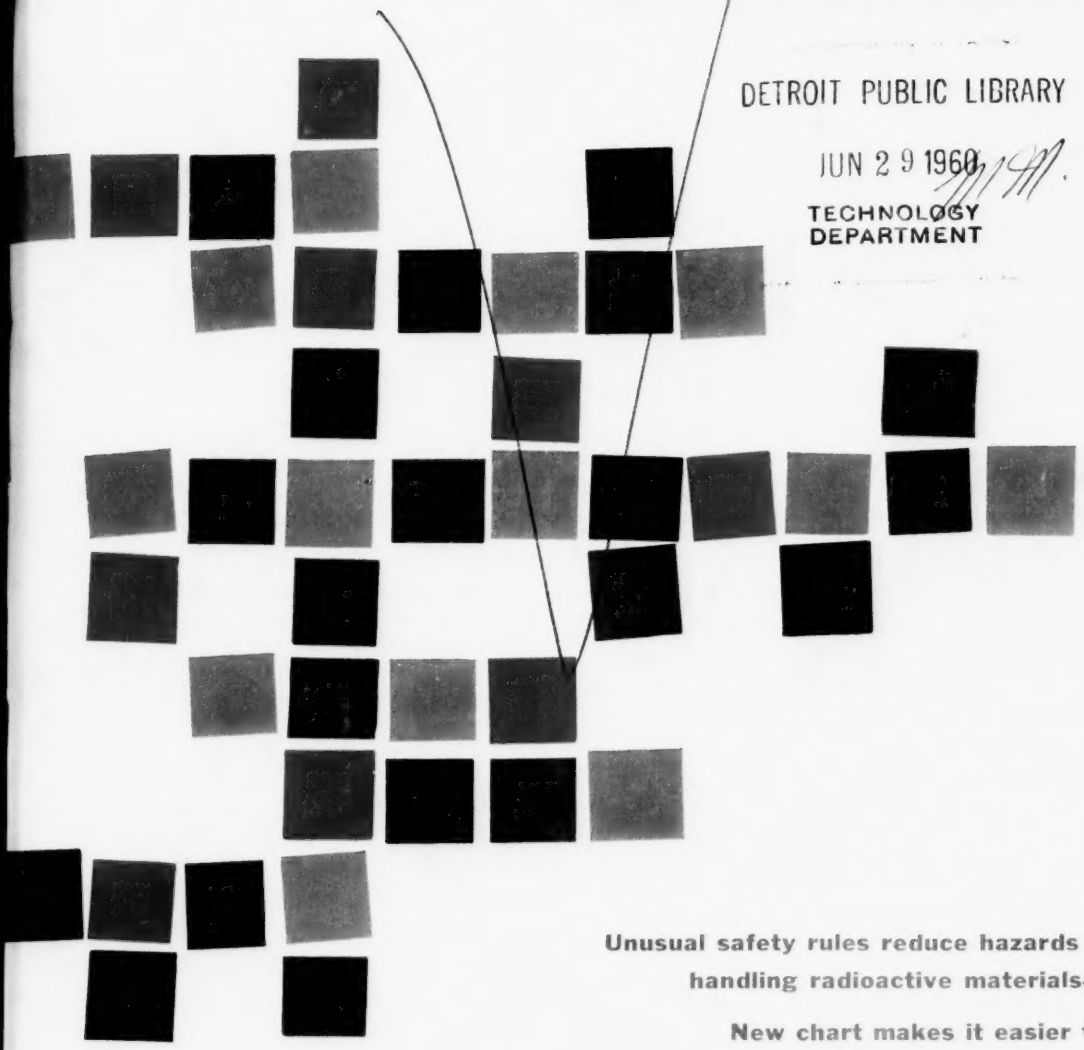
Chemical Engineering

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TECHNOLOGY
DEPARTMENT



Unusual safety rules reduce hazards in plants handling radioactive materials—p. 105

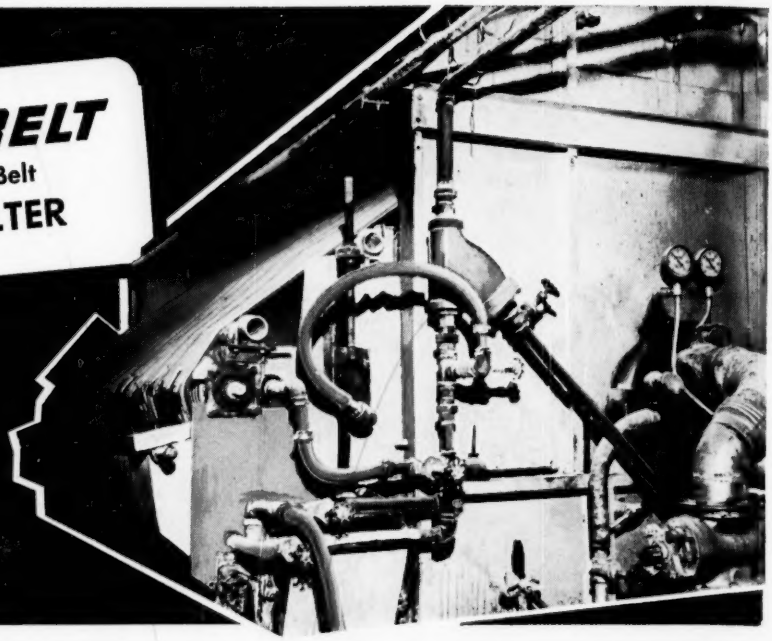
New chart makes it easier to design U-tube heat exchangers—p. 111

You can predict manufacturing costs from research and development data—p. 123

Superior treatment of its engineers earns recognition for Phillips—p. 128

Special valve designs are ideally suited for severely corrosive services—p. 146

EIMCOBELT
Continuous Belt
DRUM FILTER



Direct Filtration Eliminates Thickener

. . . Increases Product Recovery Filtering Low Density Slurry!

Not until the EimcoBelt filter was put on the market was it possible, in the beet sugar industry, to accomplish continuous carbonation without an inevitable loss in sugar quality.

First carbonation juices, an extremely low density slurry, blinds the filter media on standard drum filters immediately. In the conventional process, this slurry has to be put through a thickener before filtration. Necessary retention time in the thickener always results in "inversion," a cause of breakdown in sugar juice quality.

When a large sugar producer installed an EimcoBelt filter in this process he was able to eliminate the thickener from the flowsheet.

The EimcoBelt, because it maintains a constantly clean medium and can discharge thin cakes, is able to handle first carbonation slurry directly — without thickening and without sugar loss caused by retention time in the thickener. The result is greatly increased product recovery and improved product quality.

Eliminating the need for a thickener is only one of many ways the new EimcoBelt filter can cut processing costs.

EimcoBelt filter's new operating principle now makes it possible to filter — continuously and profitably — a whole category of difficult slurries that could not be filtered before on vacuum filters.

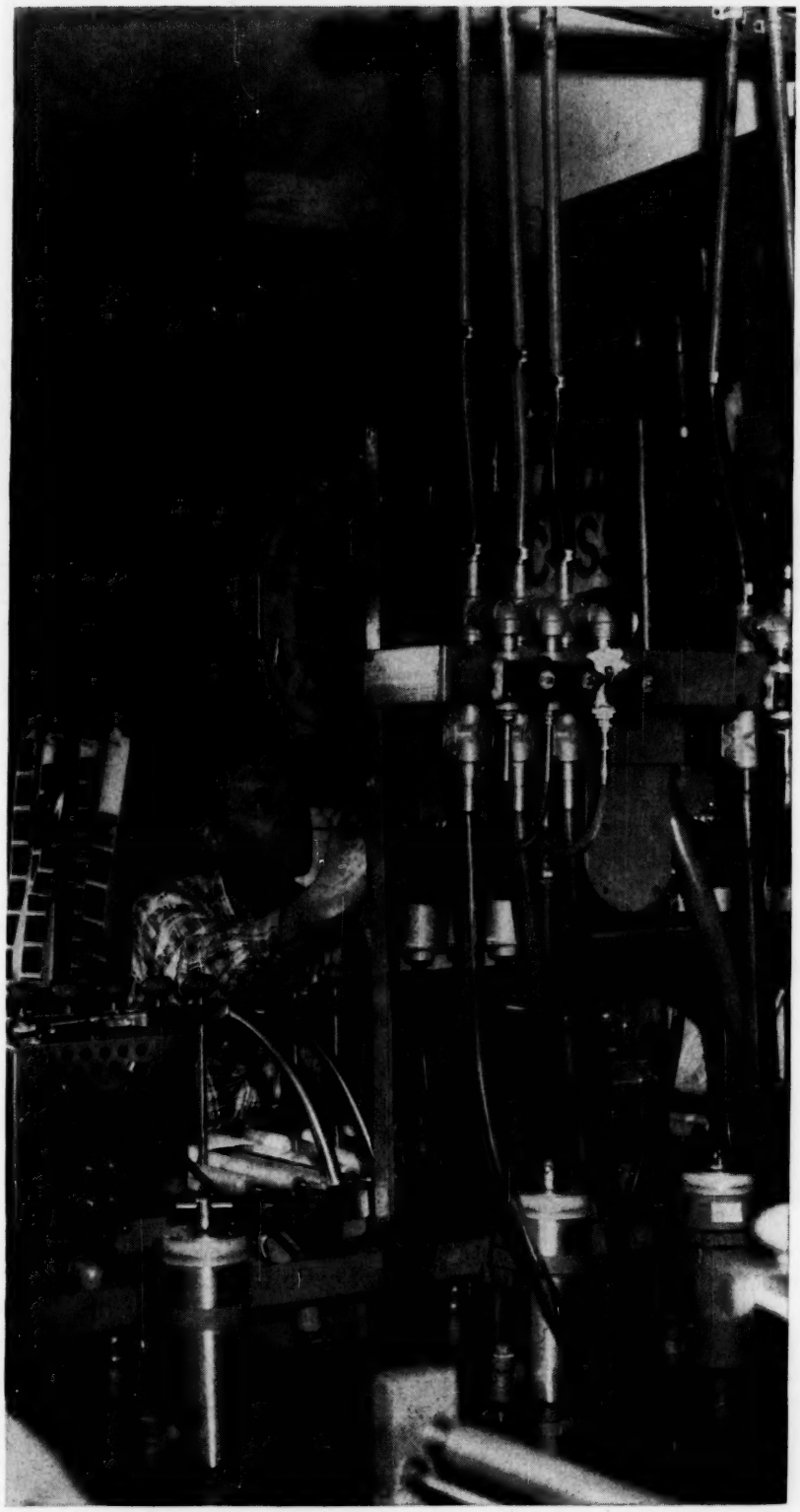
Contact the Eimco representative in your area for facts on how EimcoBelt filters can cut costs in your operations. Write Eimco Filter Division for EimcoBelt Bulletin F - 2053.

THE EIMCO CORPORATION

B - 565

FILTER DIVISION
634 SOUTH 4TH WEST
SALT LAKE CITY, UTAH — U.S.A.

RESEARCH AND DEVELOPMENT CENTER
301 SO. HICKS ROAD, PALATINE, ILLINOIS



Koroseal defeats corrosion in a photo finish

THIS photo-finishing company uses an intricate piping system to feed chemicals to color processing machines. But the chemicals are highly corrosive—so strong they ate holes in metal pipe. The leaks were costly to repair, slowed production, sometimes brought it to a standstill at the peak of a busy period. Metal pipe was being replaced frequently.

When a B.F.Goodrich distributor heard of the problem, he recommended installing pipe, fittings and valves made of Koroseal PVC. It doesn't corrode. It's unaffected by most alkalies, acids, salt, alcohol and oil. Koroseal pipe does not react chemically, will not contaminate liquids.

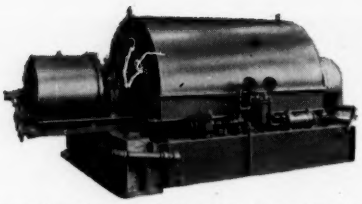
In the picture, you see only a small part of the 3000-foot Koroseal installation—now in its fifth year of trouble-free operation. There's been no contamination, no discoloration of chemicals or film, no costly downtime.

More and more companies are finding Koroseal PVC pipe ideal for use wherever chemical resistance, high working pressures, good impact resistance are factors. Longer service life and low installation costs make rigid Koroseal competitive with metal piping.

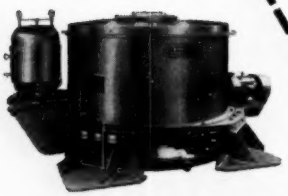
For the full story on Koroseal's many advantages, get in touch with a BFG distributor or send for a free booklet. *B.F.Goodrich Industrial Products Co., Dept. M-857, Akron 18, Ohio.*

Koroseal—T. M. Reg. U. S. Pat. Off.

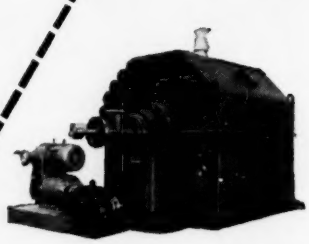
Koroseal rigid PVC products by B.F.Goodrich



Bird Continuous Solid Bowl Centrifugals come in 7 sizes, each with a great many design variations to meet a wide range of product and process needs. Shown is the largest (54 in. bowl dia.) for ton-a-minute delivery of well dewatered solids.



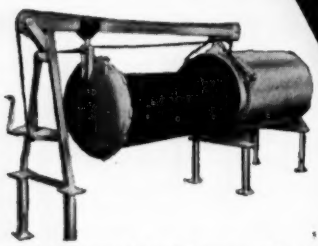
Bird-Humboldt Oscillating Screen Centrifuges dewater coarse solids (+65 mesh) with almost no degradation or loss of solids. Screens last thousands of hours. Power cost is extraordinarily low (0.2 KWA input per ton of dried solids).



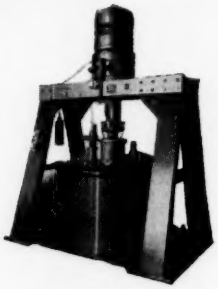
Bird-Young Rotary Drum Vacuum Filters are of unique design providing several times the usual capacity per foot of filter area, super-efficient wash, sharp wash separations and fume-tight operation when desired.

SIX WAYS TO SEPARATE SOLIDS FROM LIQUIDS

Which one is best for you?



Bird Pressure Leaf Filters provide rugged construction, large sustained filter area, high rate of flow, high working pressures (up to 75 psi standard, 250 psi special). They are custom built for the job — of corrosion resistant alloys or with special linings; insulated; steam jacketed; in a wide range of sizes.



Bird Suspended Batch Centrifuges are for heavy duty service. They come with 26", 40" or 48" basket, perforate or imperforate. All kinds of auxiliaries are availabe, also fume-tight or explosion proof construction.



Bird-Prayon Tilting Pan Rotary Vacuum Filters combine great capacity range with most effective, multistage washing, constant high output and minimum maintenance cost. They are ideal for handling materials that cannot be picked up by a drum or disc filter.

Let the *Bird Research and Development Center* help you find out. Here, under one roof, is a completely equipped and staffed, pilot-scale test plant concentrating exclusively on solid-liquid separating problems.

Bird builds the most comprehensive range of solid-liquid separating equipment, is therefore in a position to fit the machine to the job — not the job to the machine.

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June 27, 1960 **Chemical Engineering** Vol. 67 No. 13

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

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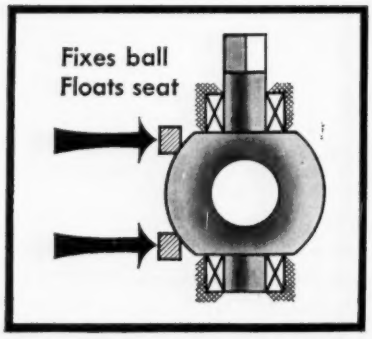
Can A Ball Valve Operate, Cycle After Cycle, With No Maintenance At All?

Read this remarkable answer, and discover an amazing engineering feat.

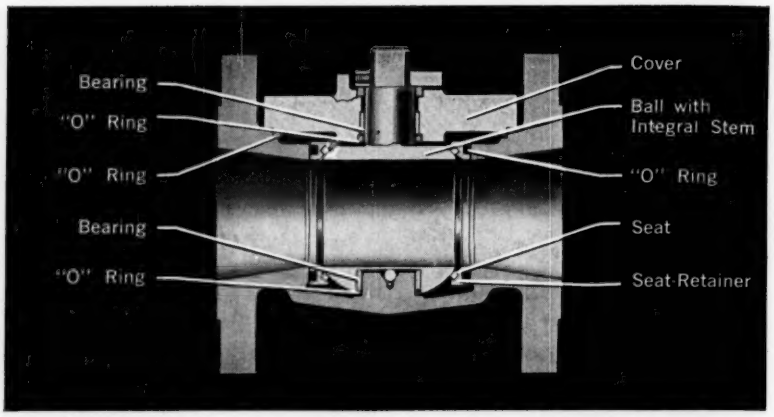
As most engineers know, ball valves offer a number of distinct advantages over all other types of valves . . . 90° on-off, minimum pressure drop, positive on-off indication, no lubrication, and compactness. In common with other valves, however, the design was insufficient to overcome the problem of continual maintenance.

Four years ago, this problem was faced by Hydromatics, Inc. in the valves that they produced for use in missiles, aircraft and ground support systems. Then, as today, all other ball valves were built with a ball that floated in its socket, and sealed by being forced against its seat by the pressure in the line. This caused seat distortion which made early replacement necessary.

Hydromatics tried a different approach. Rather than use the traditional floating ball, their engineers fixed the ball in bearings.



In the bearing-fixed **FLO•BALL** valve all pressure forces exerted on the ball are transmitted to low-friction bearings, thus eliminating down-stream seat distortion due to ball load. The pressure balanced seat, with its teflon sealing surface, is continually self-adjusted by the O-ring in the seat retainer.

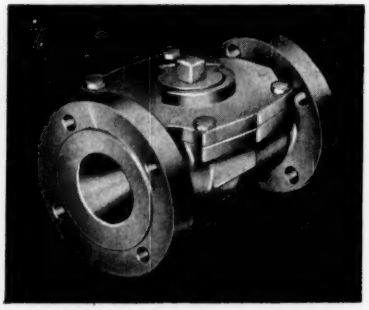


This O-ring acts as a self-energizing force that keeps the teflon seat always in contact with the ball. This insures positive sealing without seat distortion, and minimizes seat-resisting frictional forces. The combination of these low frictional forces results in low operating torque and extremely long seat life.

The bearing-fixed **FLO•BALL** valve proved itself immediately. Hundreds of missile and spacecraft systems, previously impossible, were made possible with these valves. The X-15, America's first manned space vehicle, for instance, has a Hydromatics **FLO•BALL** valve at its heart. Since its inception, the **FLO•BALL** has been used in more varied applications than all other ball valves combined.

Now, after the toughest application testing in history, bearing-fixed **FLO•BALL** valves are being mass produced for industry. They are available for off-the-shelf delivery to standard ASA dimensions in semi-steel, carbon steel, stainless steel, and aluminum. They operate at pressures to 600 psi, temperatures to 400°F and hold vacuum to 10^{-6} mm. of Hg!

The bearing-fixed **FLO•BALL** offers extra ball valve advantages. Top loading for easy access without removing the valve from the line, plus three features that are absolutely unique! Self-adjusting seats which automatically compensate for wear, proportional sealing force which automatically increases with line pressure, and the lowest torque, by far, of any valve. These combine to make the **FLO•BALL** valve virtually maintenance-free!



How long does it last without maintenance? Frankly, we don't know, since the first valves we ever built are still going strong and outlasting other valve types by more than 10-to-1. But don't take our word for it. See for yourself. Call, write or TWX for further information.

Hydromatics, Inc.
Livingston, New Jersey
Telephone: WYman 2-4900
TWX-LIVINGSTON NJ 120

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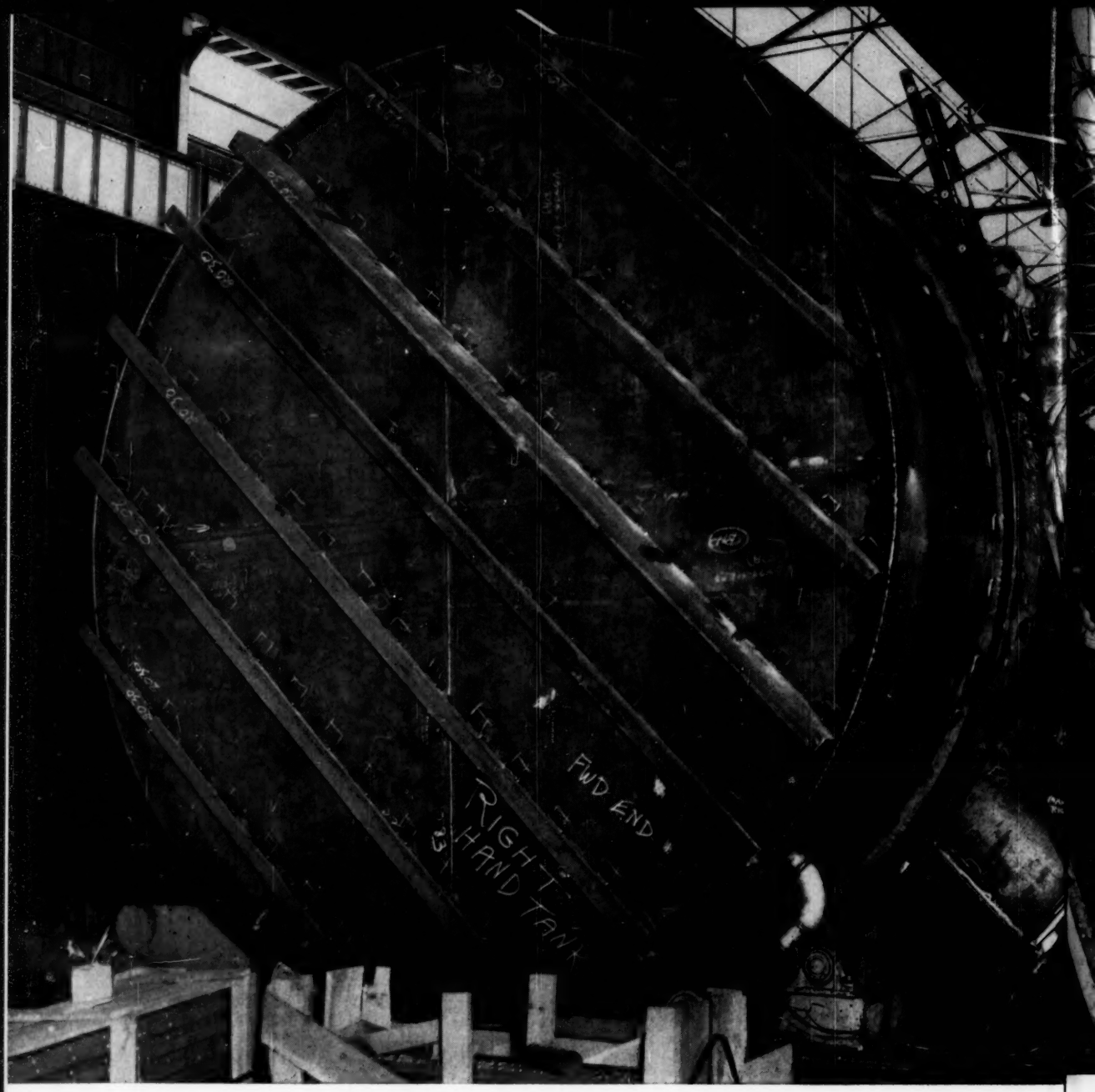
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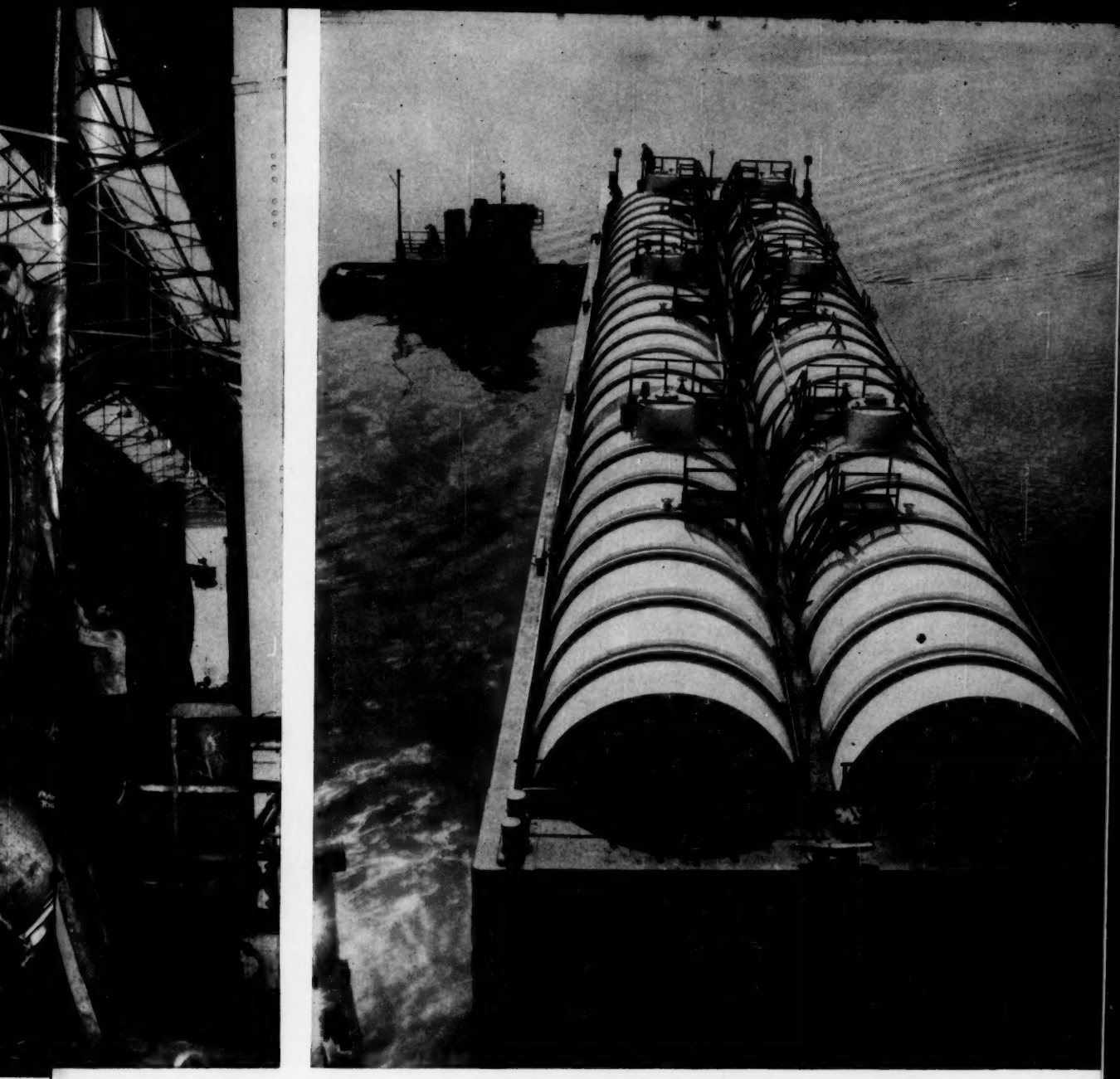
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Tanks as big as a barge can carry

These new tanks have unobstructed interiors to carry maximum cargo with least danger of con-
tamination—the essential requirements of an order for two independent tank barges from Union
Carbide Chemicals Company. One barge is designed to carry Grade A and lower liquids having
a Reid Vapor Pressure not exceeding 25 psi. The other barge will carry similar cargoes having a
Reid Vapor Pressure not exceeding 40 psi. ☐ American Bridge designed and constructed the
tanks and barges at its modern Plate Shop in Orange, Texas. The results: two Jumbo Hopper
Barges 195′ x 35′ containing six tanks 52′ long x 14′-6″ O.D. and weighing 22 tons with a tota



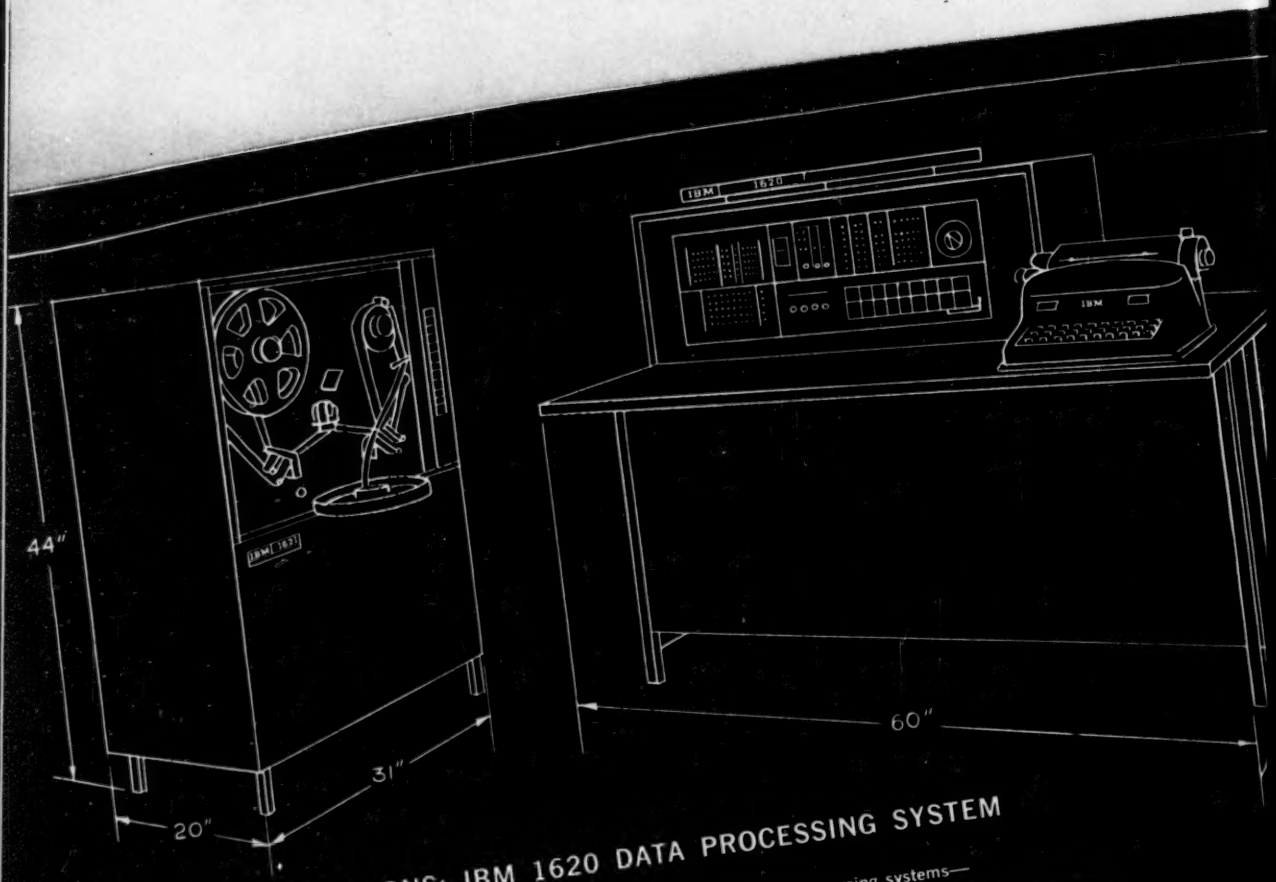
capacity of 383,000 gals. per barge. The reinforcing members for the tanks were placed on the tank exteriors leaving unobstructed nickel-plated interiors. ☐ Whatever your plate needs, we have the staff and facilities to take care of them, and our strategic location permits shipment by train, truck or barge. Write for our booklet completely describing plate fabricating and construction services.

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Core storage—20,000 digits
Automatic operation—stored programming
High computing speed—20 microsecond machine cycle
Powerful instructions with two data addresses
Decimal and alphabetic
Variable field and record length—any size numbers

Advanced programming systems—
Fortran and symbolic programming
Compatibility with other computers through Fortran
Simple console with logging features
Self checking throughout
Transistorized circuitry—
compact, economical, reliable
Paper tape input and output

The 1620 will meet technical computing requirements too complex for the conventional desk-type calculator. It provides many advantages of larger systems at a much lower cost. In addition, it can be used to support other data processing systems such as the IBM 650, 704, 705, 709, 7070 and 7090.

Information enters the system from the typewriter of the 1620 Central Processing Unit, or from the 1621 Paper Tape Reader. Output is to the typewriter or 961 Tape Punch.

Machine	Weight in lbs.	Current Requirements	Power cord	Interconnecting cable	Heat Load Specification BTU/Hr
1620	1,000	20 Amps., 115 Volts, single phase	10' 3-Wire for 115 and 230 Volts	10' signal	5,000
				10' power	
		10 Amps., 230 Volts, single phase			
		6.5 Amps., 208 Volts, three phase	10' 4-Wire for 208 Volts	——	2,000
		——	——		
1621	280				



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RELIEVES YOUR STAFF OF TIME CONSUMING WORK

...SOLVES WIDE RANGE OF SPECIALIZED PROBLEMS

Problems that used to tie up your engineering staff for days can now be solved . . . with electronic accuracy . . . in minutes! The IBM 1620 is a low-cost, desk-size engineering computer that solves a tremendous range of chemical engineering problems quickly and easily. The 1620 offers you an economical way to increase staff productivity, helps pave the way for profitable growth.

The 1620 is easy to learn, easy to operate, easy to communicate with. It adapts readily to such specialized problems in the chemical industry as design development, blending problems involving matrix arithmetic, research calculations with differential equations, problems in kinetics, reactor design, statistical design of experiments, and evaluation studies employing techniques such as regression analysis.

IBM also makes available a comprehensive library of mathematical routines and programs as well as reliable customer engineering. These services supporting the 1620 are an important part of IBM Balanced Data Processing. They make it easy for you to make full use of the 1620 in your operations without delay. Like all IBM data processing equipment, the 1620 may be purchased or leased.

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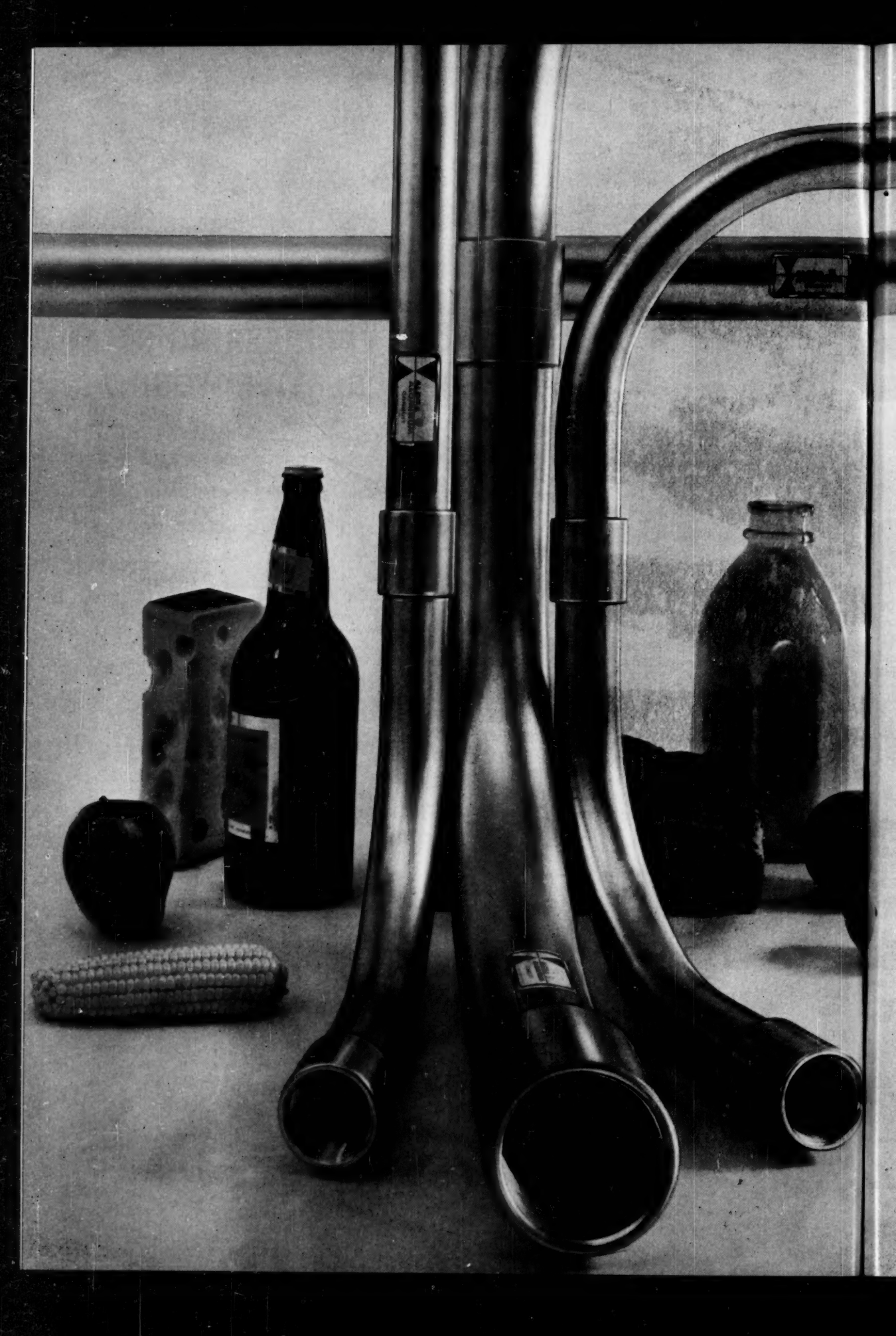
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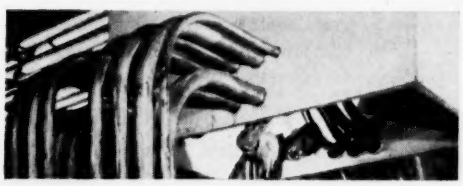
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Where **PRODUCT PURITY** is important, protection gets a hand from Alcoa

When protection against contamination from *any* source is vital, take a look at what Alcoa aluminum electrical rigid conduit offers. ¶ It needs *no* protective coating, because it forms its own—an oxide film that repairs itself when damaged. ¶ It's corrosion-resistant—stands up particularly well against acids commonly present in food plants: citric, acetic, tannic. And the compounds that might form when aluminum is used are in most cases *nontoxic*, completely safe. ¶ What else? Aluminum is lightweight (weighs about 1/3 as much as steel), so it's easier to install. Alcoa conduit is also nonmagnetic, nonsparking, and neat appearing. ¶ Consider all costs—initial, installation, maintenance—plus long service and you'll see why Alcoa aluminum conduit is a sound investment. ¶ For full details, contact one of our nearby representatives. Or write to Rome Cable Division of Alcoa, Dept. 22-60, Rome, New York.

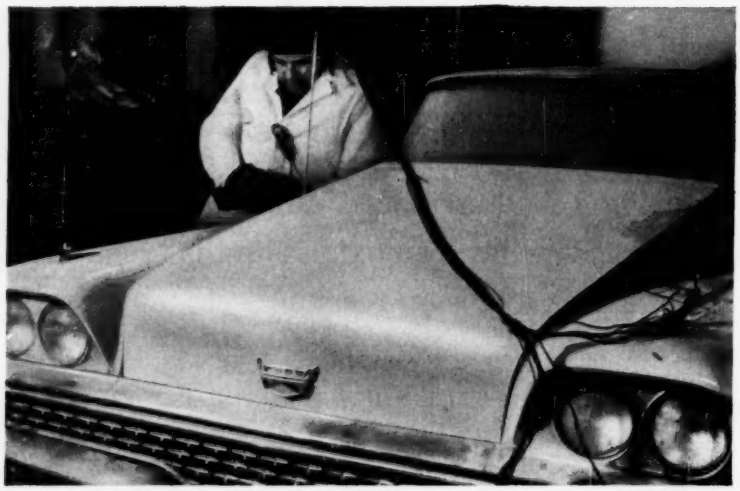


◀ ADDED PROTECTION against product contamination is provided by Alcoa aluminum conduit. It needs no protective coating, resists corrosion, and is nontoxic.

ROME CABLE
DIVISION OF **ALCOA**

NEW ANTI-

PARADYNE



PARADYNE 41 PASSES STIFF ANTI-STALLING TESTS

The photograph shows a car undergoing stalling tests in a controlled temperature room. Paradyne 41 inhibited gasoline gave outstanding performance under the most critical conditions.

provides maximum protection against engine stalling

Paradyne 41 prevents troublesome carburetor icing . . . the most common cause of stalling in the fall, winter and spring seasons. A combination of phosphorus-containing compounds, Paradyne 41 forms a protective water- and ice-repellent film on metal surfaces . . . preventing agglomeration of ice crystals on carburetor surfaces.

ALSO PREVENTS RUST

Test panels immersed in Paradyne 41 inhibited gasoline showed no rust after 40 days.

SAVES MONEY ON PHOSPHORUS

At concentrations normally used for anti-icing, Paradyne 41 provides an appreciable portion of the phosphorus required to modify combustion deposits...thus reducing the amount of additional phosphorus additive required to prevent misfiring and surface ignition.

PERFORMANCE PROVEN BY THOROUGH FIELD TESTING

Extensive field tests, closely controlled test car studies and large-scale distribution studies . . . substantiate service qualities shown by Paradyne 41 in laboratory test engines.

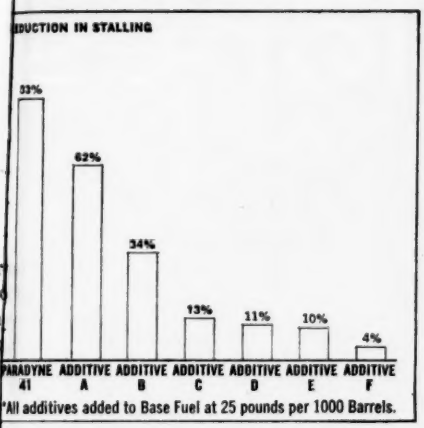
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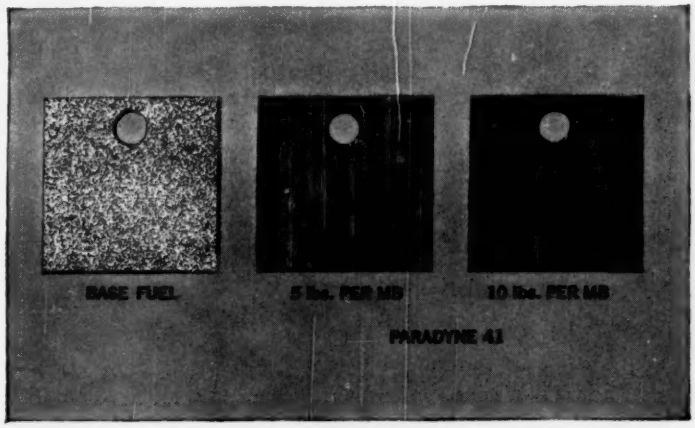
May be handled as a petroleum product . . . with normal precautions used in handling phosphorus additives.

ENJAY
ADDITIVES

TI-STALL

E41 GASOLINE ADDITIVE!





RADYNE 41 PROVEN SUPERIOR

e bar chart shows the anti-stalling effect Paradyne 41 and six other leading addi-es when compared with the additive-free soline. Under test conditions, additive-free soline allowed 22 out of 25 possible stalls. radyne 41 reduced the stalls to less than ur out of 25 – a reduction of over 83%. radyne 41 excels in anti-icing effectiveness en under the most critical temperature and midity weather conditions.

LL UPON ENJAY FOR PRESCRIPTION-LANCED ADDITIVES THAT

- meet your exacting specifications
- help you market your products successfully

he new Paradyne 41 Technical Service Bul-tin, and information about improving your roduct's performance with a Prescription-alanced Paramins Package, are yours for e asking.

TEST PANELS SHOW PARADYNE 41 ANTI-RUST EFFECTIVENESS

Rusted panel at left was immersed in gasoline over synthetic sea water for three days. The other panels were subjected to same conditions for 40 days, but gasoline was inhibited by small concentrations of Paradyne 41. Note that these panels are rust free.

ENJAY SERVES YOU

. . . with a *complete* line of petrochemicals to improve fuels and lubes • with a larger staff devoted exclusively to additives research and manufacture . . . a staff available to help you meet your special additives requirements • with quality controls at every production step to assure that each order meets specifications • with expedited deliveries from Enjay product centers across the country.

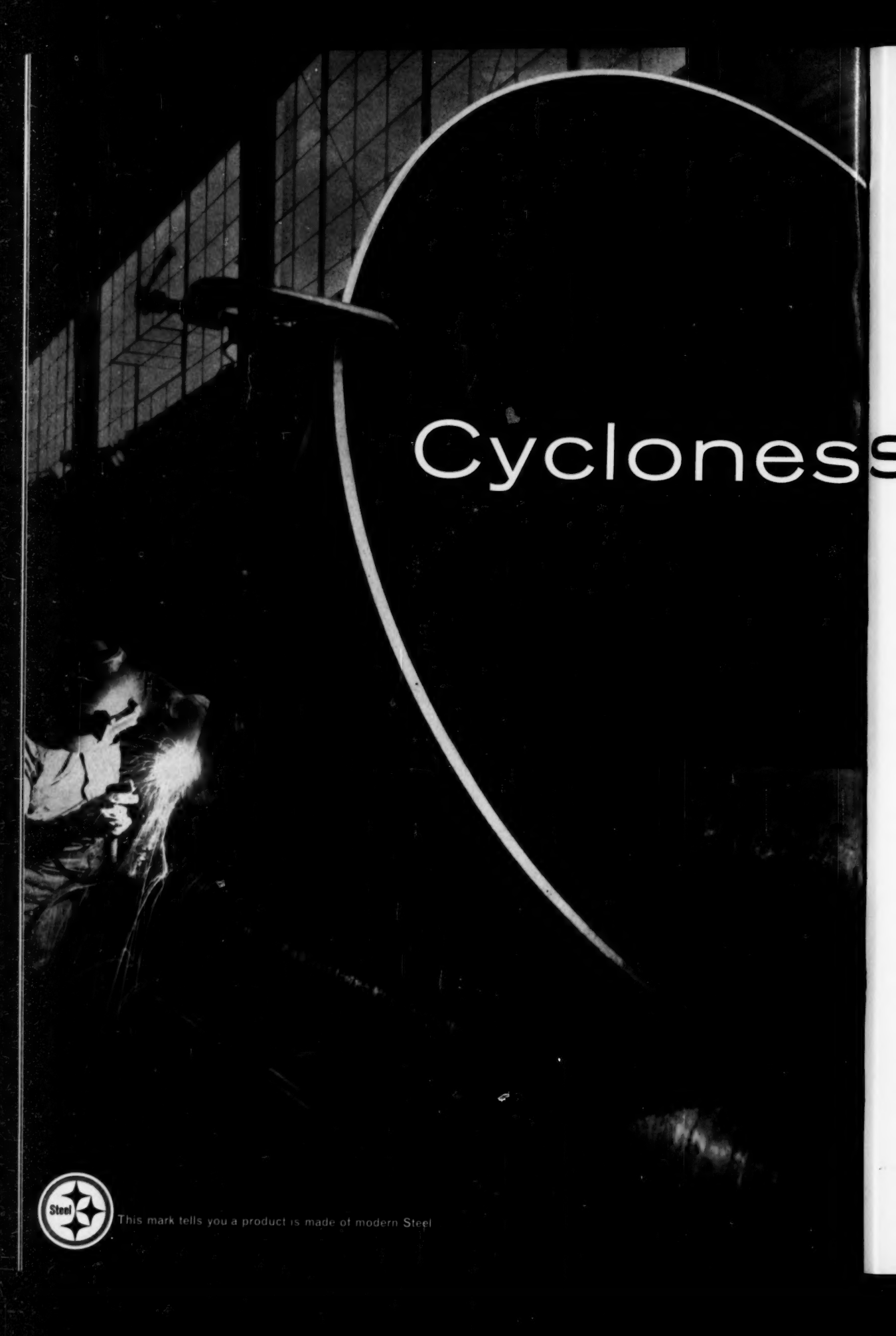
Want more information? Contact the nearest Enjay office: (Home Office) 15 West 51st Street, New York 19, N.Y. (Other Offices) Akron • Boston • Charlotte • Chicago • Detroit • Houston • Los Angeles • New Orleans • Tulsa • Toronto

ENJAY
ADDITIVES

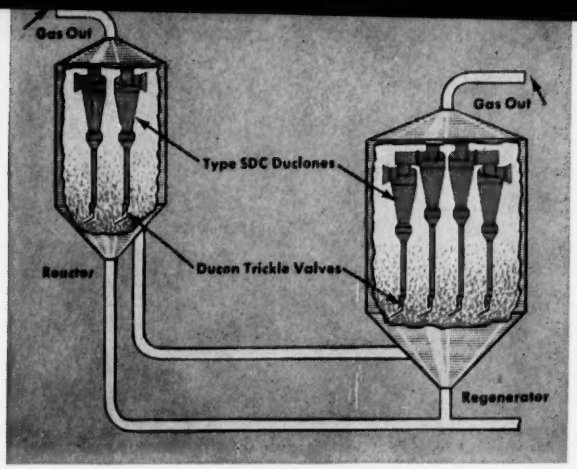
EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY CHEMICAL COMPANY

DIVISION OF HUMBLE OIL & REFINING COMPANY



This mark tells you a product is made of modern Steel



General arrangement of Ducon cyclones in the reactor and regenerator of a fluid catalytic cracking unit. Stainless cyclone collectors keep catalyst loss to a minimum. "Duclone" is a registered trademark of the Ducon Co.

start here...

. . . and end up in fluid bed cat crackers where they circulate up to 60 tons of catalyst every minute. At $400 to $500 a ton, lost catalyst can put a lot of red ink into a refinery's operating budget. Breakdowns cost from $20,000 to $50,000 a day. That's why it is so important to design with the right material from the start: USS Stainless Steel.

Stainless Steel cyclones used for catalyst recovery are subjected to extreme heat and erosion. Temperatures in a regenerator unit can go as high as 1400° F. At high temperatures elemental sulfur corrosion would eat out most materials in nothing flat. Not Stainless. And Stainless Steel retains its strength at high temperatures. Stainless cyclones aren't in danger of changing shape which could cause catalyst loss.

Nothing equals Stainless Steel as a solution to the many complex problems in a refinery. It has outstanding corrosion resistance for a wide range of reagents, excellent high temperature strength. Its smooth, dense surface won't harbor contamination, is easy to clean. Above all, USS Stainless Steel promises long life and low maintenance. Order USS Stainless Steel through your USS representative or your local Steel Service Center.

If you are interested in more information about these Stainless Steel cyclones, wire or write U.S. Steel, Room 6104, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS is a registered trademark

Left, welder completes longitudinal seam of one segment of the cyclone at The Ducon Company's Mineola, N.Y. plant. **Below,** stainless steel cone is removed from the forming rolls.



USS

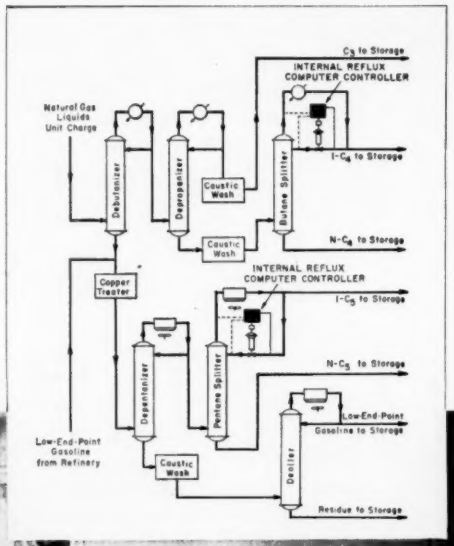
United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
National Tube—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

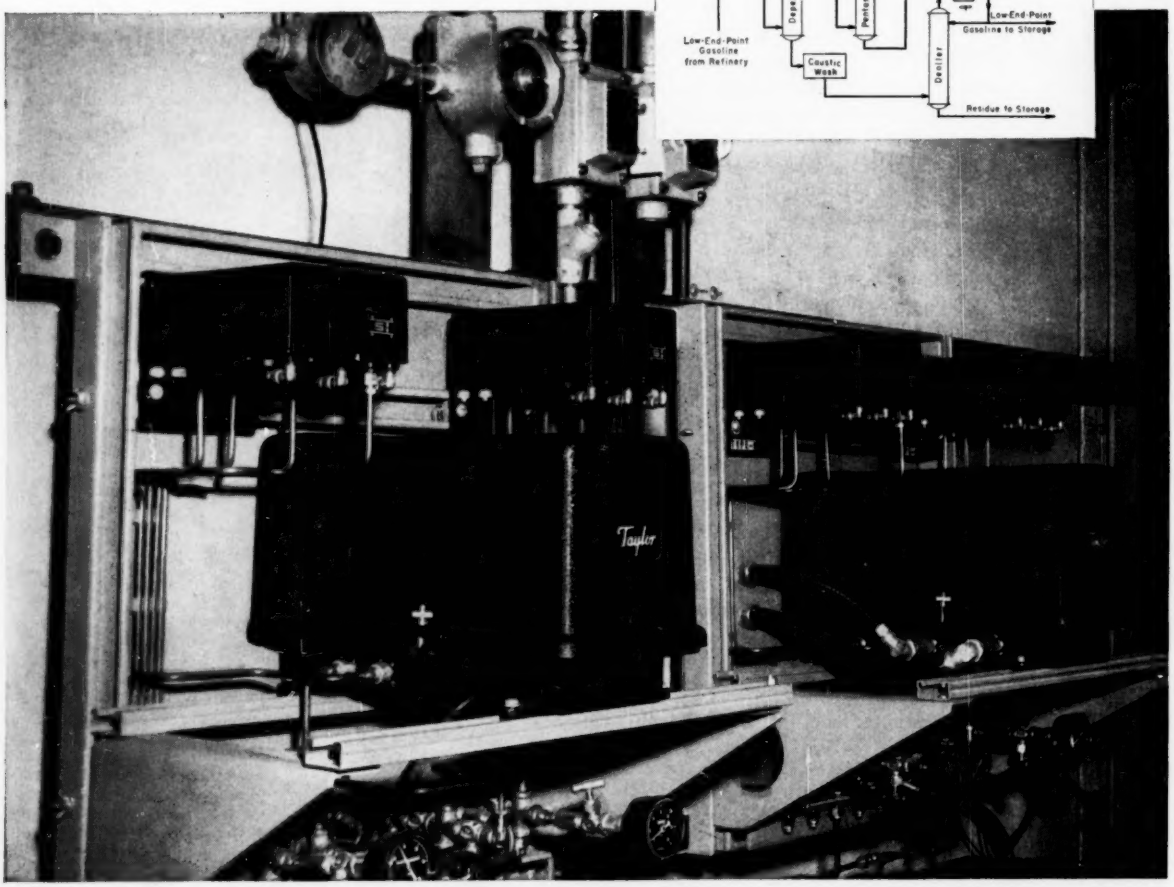
United States Steel

MORE PROFIT PER

Drawing at right shows the Taylor Internal Reflux Computer System, installed at Phillips' Sweeny, Texas, Refinery on LP gas fractionation columns. It can be supplied with either pneumatic or electrical output. It fits into any control system already installed—also into any large scale digital or unit analytical computer installation. Set point can be adjusted manually by the operator or automatically from column temperature, process analyzers and/or computers, etc.

Components are all standard, proven units. The Taylor Potentiometer Transmitter permits the use of thermocouples in place of special resistance elements for narrow span differential temperature measurement.





Taylor Computer-Controllers in use on the light ends fractionation system, typical of several systems in use as shown in drawing above.

Taylor Instruments

BARREL OF PRODUCT...

Phillips Petroleum Co. reports optimum fractionator efficiency with Taylor Internal Reflux Computer Control

THE Taylor Internal Reflux Computer Control System consists of the addition of a simple analog computer to a fractionating column. It maintains optimum reflux flow by instantly compensating for climatic effects encountered in outdoor installations. This means:

1. Consistent product quality—no rerunning or blending.

2. Maximum utilization of existing installation.

3. Minimum consumption of steam, air and water.

4. Elimination of flooding—run to design capacity without loss of product.

5. Increased production with no process change. Adaptable to any column design and existing piping and instrumentation.

• • •

Here are Phillips Petroleum Company's answers to questions commonly asked about this system:

Are steam savings effected when using Internal Reflux Computer Controls?

"They minimize reflux adjustments necessary for day and night ambient temperature changes, thereby effecting steam savings. At the same time they contribute to the maintenance of overhead product specifications. A lower reflux ratio obviously saves steam".

Are increased product yields realized by use of computer-controls?

"While it is difficult to pin-point exact increases, we can say they permit continued tower operation at maximum load levels. Without reflux computer-controllers, column operation must be at a less efficient level to reduce hazard of flooding".

Does use of computer-controllers permit use of lower reflux-to-product ratio?

"Yes—particularly when operating to maintain product specifications, such as a minimum of 95% isopentane overhead product. Without computer-controllers it would be necessary to operate at 97% isopentane to insure a minimum 95% product".

Do computer-controllers help meet product specifications?

"Yes—they compensate and 'short-stop' transient column conditions resulting from minor temperature, pressure and feed composition changes. It is no longer necessary to have product samples analyzed in the laboratory to serve as a guide for the operator to make changes in external reflux flow rate".

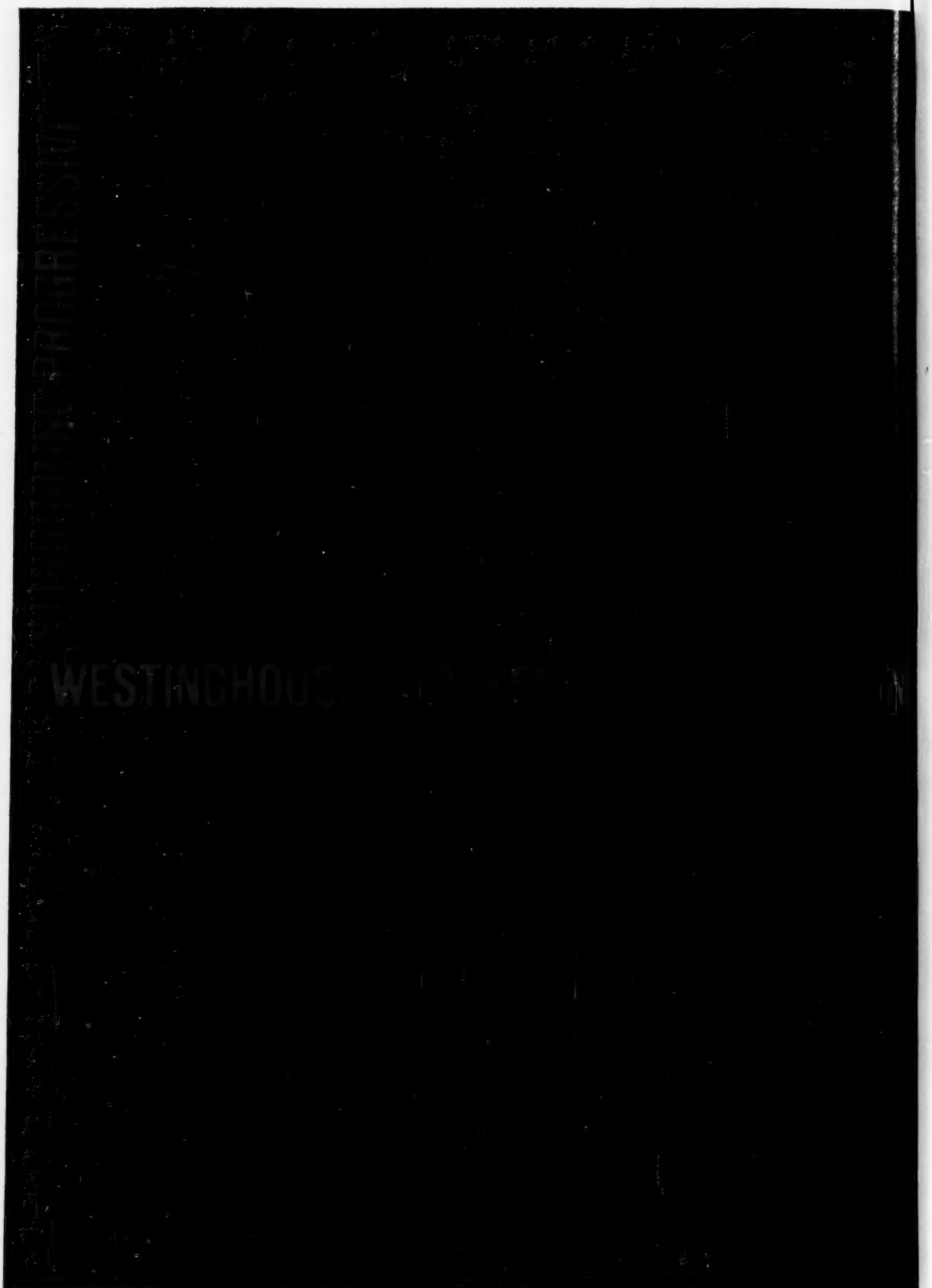
Are plant operators pleased with the performance of computer-controllers?

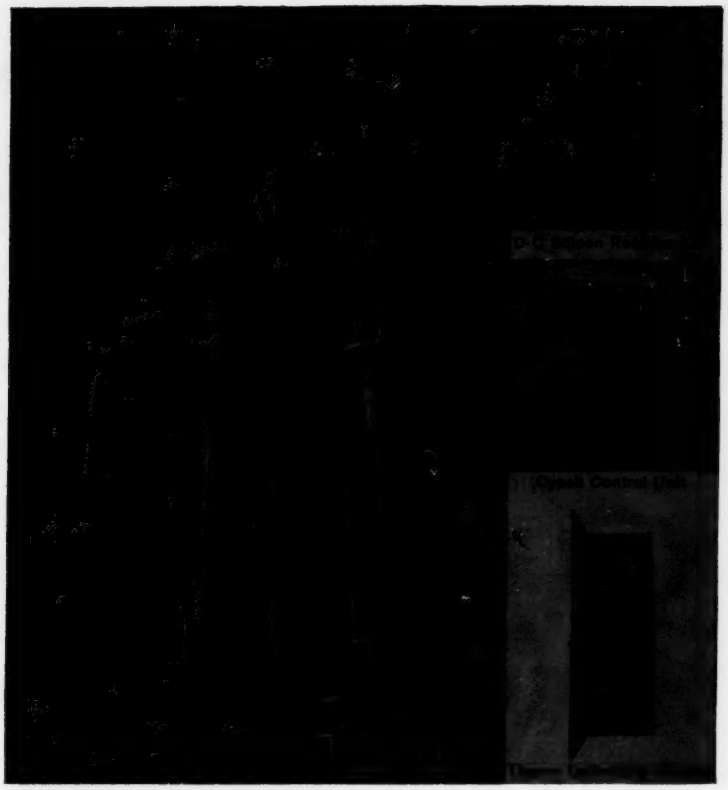
"They are well pleased with the installations. They appreciate the smoother column operation and ease of meeting product specifications."

• • •

Ask your Taylor Field Engineer about this system, developed and licensed by Phillips Petroleum Company, or write for **Bulletin 98374.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ontario.

MEAN ACCURACY FIRST


PROGRESS



WESTINGHOUSE PROGRESSIVE AUTOMATION CAN HELP YOU ACHIEVE PLANT FLEXIBILITY, INCREASED POWER EFFICIENCY, ACCURATE PROCESS CONTROL

Rapid changes in chemical processing techniques represent the major problem confronting the industry. How to optimize profits from the present plant investment? How to utilize existing facilities when newer production processes are developed?

Westinghouse is ready to help you plan *economical steps* to automatic production, to achieve your goals without over- or under-automating. Westinghouse Progressive Automation is an individualized plan to gain higher product quality through step-by-step control of operations...a long-term plan with minimum capitalization.

The dynamic growth of the entire chemical industry finds many electrical systems badly overloaded without adequate protection . . . and narrowly limited to adaptability to changing electrical needs. Powering-Up with an adequate electrical system is a logical first step (on the road to fully automatic production) recommended by Westinghouse.

To help the industry provide more efficient means of supplying the large blocks of direct current, Westinghouse developed the silicon rectifier for all voltages. Compared to other types of rectifiers, the high efficiency of Westinghouse silicon rectifiers permits power savings of $50,000 in a typical installation rated 100,000 amps, 300 volts d-c.

Alarm systems that monitor critical variables were an early step in automating process control systems. Chemical plants have found almost 100% reliability in their control panels with the addition of the Westinghouse Cypak® . . . static switching unit.

Combining groups of control loops is already being investigated in experimental chemical plant installations. This advanced stage of automatic production utilizes data logging and digital computers.

Before maximum automation is practical in the chemical industry, two steps must be accomplished: more direct measurement of variables, and development of additional process data.

Additional Westinghouse experience to guide you in automating your plant was gained in production of *Prodac**. . . first applied to automatic steel-mill rolling. Opcon,* an associated development, experimentally controls process variables to select the *optimum* operating conditions.

And when widely separated functions are ready for central control, look to Westinghouse for experience and equipment for industrial communication and control through multiplex telemetering and microwave transmission.

Today, and for the first time, there is *one* source for control and computer systems and all basic electrical equipment for the chemical industry. Call your local Westinghouse representative for complete information on PROGRESSIVE AUTOMATION. J-96145

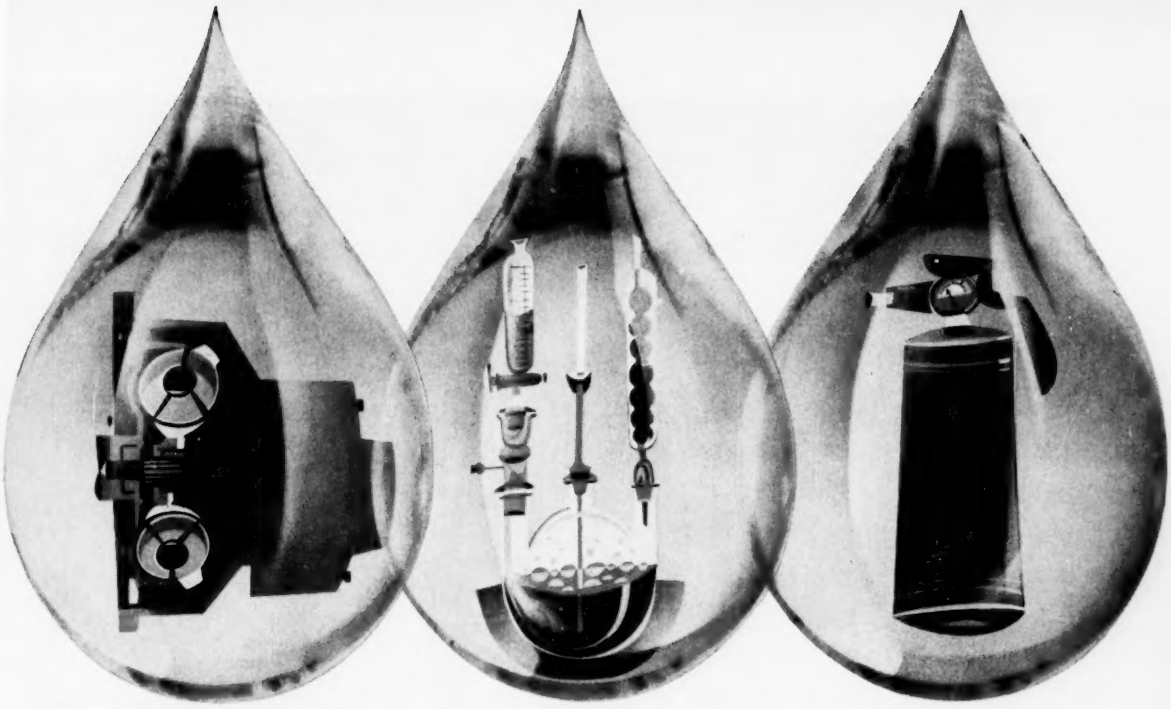
*Trade-Marks

YOU CAN BE SURE...IF IT'S Westinghouse

TUNE IN WESTINGHOUSE-CBS TV-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

DOW | BROMINE DEVELOPMENTS

RESEARCH CREATES NEW USES FOR THE UNIQUE PROPERTIES OF BROMINE



Build High Density Fluids

Bromine is more than three times heavier than water. Hydraulic engineers, for example, find this property valuable in developing high density fluids to make possible more compact hydraulic systems without sacrificing efficiency.

React Fast

Because bromine is highly reactive, it's extremely easy to add bromine onto a compound, or to take it off. With bromine or brominated compounds, the reactions are fast, often avoid undesirable side-reactions, unwanted by-products.

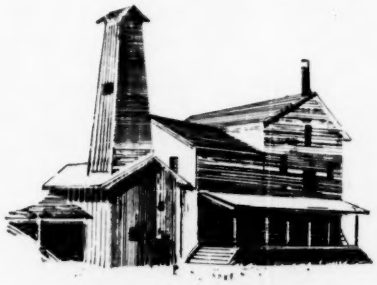
Fight Fire

During World War II, specialized military fire-fighting jobs began to rely on certain brominated compounds for fast action. Use has spread to industrial applications, and current research shows additional bromine compounds of great value.

For years, the unique properties of bromine and brominated compounds have sparked the creative imaginations of scientists. In fact, they've found hundreds of individual uses, and the list keeps on growing! The three characteristics described above stand out in the spotlight of current development work to improve commercial products and processes . . . and to make new ones possible.

Most likely, new developments for *your company* depend on industrial chemicals and technical knowledge to put them to work. When your needs call for bromine or brominated compounds, we suggest you call in Dow. Our latest investigations are in the areas of new fast-acting chemical intermediates, high density fluids and fire-fighting agents.

Besides providing highly pure elemental bromine, Dow also upgrades it into hundreds of compounds—both standard items and chemicals compounded to "prescription." New brominated compounds are constantly being studied. Furthermore, Dow offers its research facilities and vast experience for developing bromine's ability to serve your particular needs. For further information, return the coupon below.



Bromine was Dow's first product. The sketch shows founder Herbert Dow's first plant where, in 1891, he perfected the electrolysis method for producing bromine in commercial quantity from brine wells in Midland, Michigan. Later, Dow pioneered the recovery of bromine from sea water. In the past decade, Dow also pioneered the bulk shipment of bromine. Today, The Dow Chemical Company with expansive modern facilities continues as a major producer of high-quality bromine and its compounds, with nearly 70 years' background of experience and highly developed knowledge.

Send coupon today

Chemicals Merchandising Department 650AK6-27, The Dow Chemical Company, Midland, Michigan.

Send information about:

- ☐ Bromine and brominated compounds
- ☐ Chemical intermediates
- ☐ High density fluids
- ☐ Fire extinguisher fluids

We are interested in bromine for use in _____

NAME _____

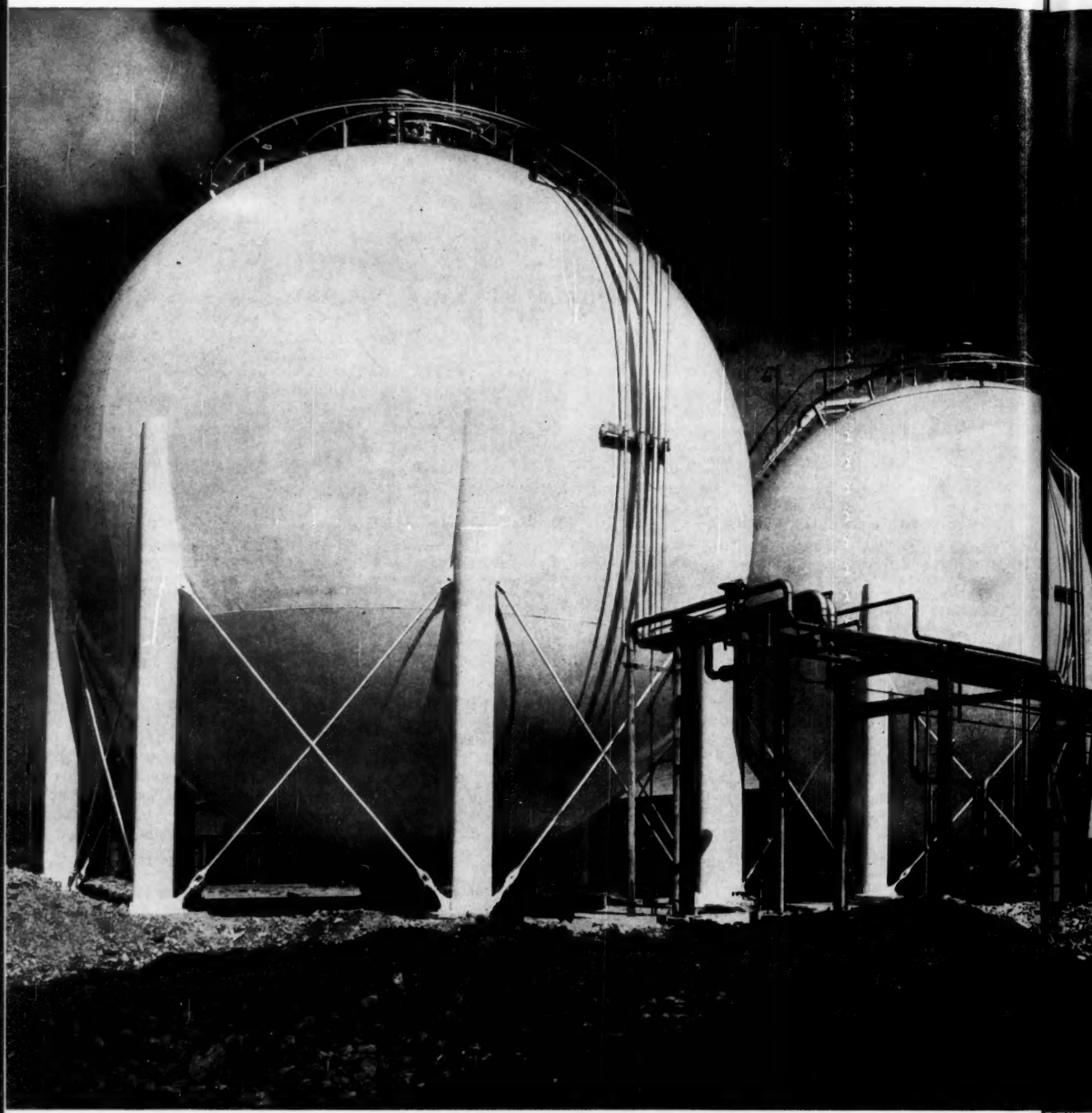
TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN



Hortonspheres built of USS "T-1" Steel for Compania Cubana Del Nitrogeno, S. A., Matanzas, Cuba.
Designed, fabricated and erected by Chicago Bridge & Iron Company.

This mark tells you a
product is made of modern Steel.



Weight cut 50%

in USS "T-1" Steel pressure vessels

Each of these two Hortonspheres in Matanzas, Cuba, has a capacity of 8,750 barrels of anhydrous ammonia. They are 45.5 feet in diameter and each shell weighs about 311,350 pounds. By designing them with USS "T-1" Constructional Alloy Steel, to an allowable working stress of 32,400 psi, the plate thicknesses were reduced to 1.109 inches and 1.075 inches. This is about 50% less than if A212-Grade B fire box quality steel had been used.

Result: Only 363 tons of USS "T-1" Steel were needed for both tanks, reducing by one-half the amount of steel that would otherwise have been required. Freight, handling, welding and erection costs were less—and the user got a stronger, tougher vessel with an overall saving in cost.

Fabrication steps: Plates of USS "T-1" Steel in widths of 78 inches and 115 inches, and in lengths up to 19 feet 2-1/2 inches, were shaped cold and field stress relieved. Column plates and some shell plates were stress relieved in the shop. Electrodes used in field welding were low hydrogen type of the E110 strength level and all field welds were 100% radiographed. With a minimum yield strength of 100,000 psi, plus toughness, weldability, and high resistance to impact abrasion, USS "T-1" Steel is ideally suited for many applications throughout industry. Write for our latest booklet. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. *USS and "T-1" are registered trademarks*

Hortonsphere is a registered trademark of Chicago Bridge & Iron Company

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
National Tube—Pittsburgh
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company
United States Steel

USS



Typical control panel at Union Carbide's Institute Plant has over 100 Foxboro Consotrol* indicators, recorders, and controllers.

for Union Carbide's Institute Plant...rapid,

A sprawling chemical metropolis, stretching as far as the eye can see. That's Union Carbide Chemicals Company's Institute, West Virginia plant — producer of Ucon† Fluorocarbon propellants and refrigerants.

Foxboro instrumentation is used to help control 20 of the different processing units at the Institute Plant. Over 10,000 Foxboro indicators, controllers, recorders, and transmitters are used, as well as thousands of Foxboro control valves.

Union Carbide reports favorably on their Foxboro instruments. "In general, we find them easy to work on, easy to repair, easy to maintain." And the company adds, "we appreciate the ability of the Foxboro engineers who work with us."

*Reg. U. S. Pat. Off.
†Trade-mark of Union Carbide Chemicals Co.

Process is hydraulic — requires fast, sensitive instrument response.

sensitive Foxboro control

You'll like working with Foxboro, too. Unsurpassed instrumentation, both pneumatic and electronic; unsurpassed engineering and service. Ask your local Foxboro Field Engineer for the complete story. Or write for Bulletin 13-18. The Foxboro Company, 366 Neponset Avenue, Foxboro, Massachusetts.

FOXBORO

REG. U. S. PAT. OFF.



Lab analysis is done right in the control room of this Carbide processing unit. Necessary process adjustments can be made on Foxboro controllers the minute technician detects the need.

See why ALCOA ALUMINUM makes a good design habit

Requirement: metal pipe and tube to insure corrosion-free fluid handling at low initial cost and minimum upkeep

Key to good design: specify low-cost, trouble-free tubular products of Alcoa Aluminum

The overpowering volume of pipe and tubing needed in the process industries makes it one of the biggest single material investments in most plants. Historically, the repair, maintenance and replacement of piping systems has been too, one of the biggest causes of an alarming increase in maintenance costs. Both factors make vital a clear understanding of the rather remarkable advantages of aluminum pipe and tube.

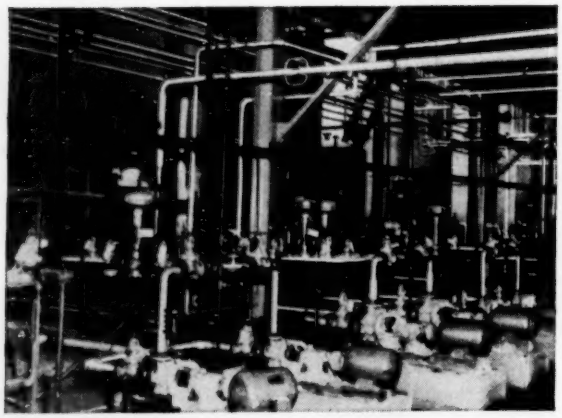
First of all, from a cost standpoint, aluminum is very frequently the lowest cost material suitable for a wide variety of applications in moving fluids through a plant. Consider, for example, the fact that the initial cost of aluminum may often average as much as 50 per cent less than that of admiralty for identical applications. Even greater savings apply when other metals such as stainless or mild steel are compared with aluminum.

Beyond these initial cost savings, aluminum provides significant maintenance benefits. For instance, no other commonly used metal offers aluminum's great resistance to corrosion. And the corrosion resistance for specific alloys exposed to particular environments can be determined from a substantial body of factual service data accumulated by ALCOA over the past 40-odd years.

It is hardly surprising that aluminum, in a variety of tubular forms, is gaining the confidence of more and more designers and builders in the process industries . . . as suggested by the aluminum applications described on these pages. ALCOA's engineers are anxious and willing to share their factual knowledge of aluminum which inspires this confidence. They are doing so through a series of engineering conferences being held this year in major cities around the country. Your local ALCOA sales office will be happy to furnish details.

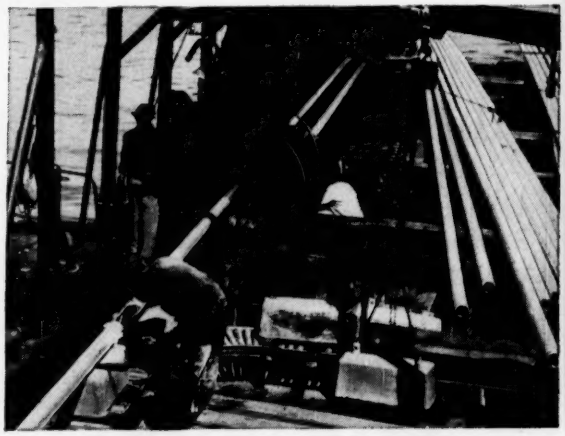
You may also wish to avail yourself of the body of ALCOA literature which describes in technical detail the known performance characteristics of aluminum in a variety of process industries applications. Simply fill in and mail the coupon opposite.

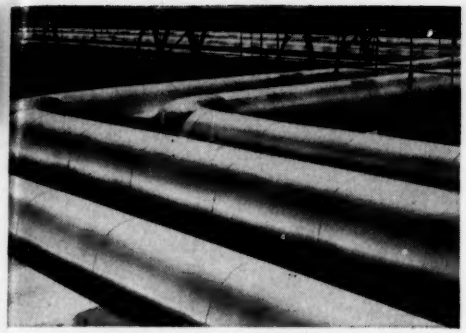
World wide sales through ALCOA INTERNATIONAL, INC., 230 Park Avenue, New York 17, N.Y.



Process piping of Alcoa Aluminum is shown here in a system designed to handle liquid sugar. The natural corrosion resistance of aluminum prevents contamination of the syrup, insures long service life and prevents excessive maintenance. Its scavenging action reduces undesired heavy metal contamination, thereby improving the end product. And aluminum's low friction factor permits fast flow without excessive pumping costs.

This aluminum pipeline is shown being welded and laid in Lake Maracaibo, Venezuela. Aluminum—without special coatings—has proved highly suitable for this operation because it resists so well the corrosive attack of the brackish waters in the lake. Since no coating is required, the low initial cost of the aluminum has proved a significant benefit. The light weight of the aluminum pipe speeded laying operations, and it has no vulnerable coating which would require babying the pipe.

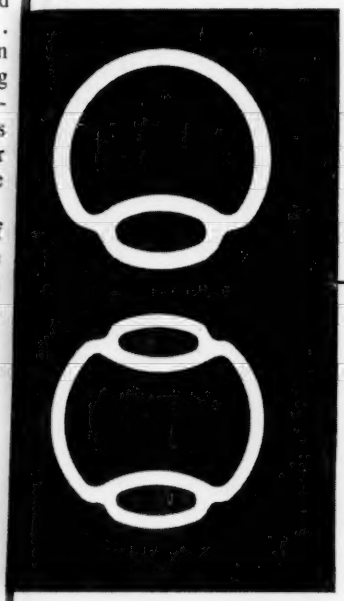




Alcoa Aluminum jacketing keeps the thermal insulation on these large diameter steam lines fully effective. The light, bright aluminum jacketing shields over 5½ miles of piping and insulation from rain, snow, dirt and ice while providing effective protection against a highly corrosive industrial-marine atmosphere.

New UNISTRENGTH® pipe by Alcoa now makes it possible to design low-cost welded aluminum lines with uniform bending, bursting and tensile strength throughout their length. The secret is a reduction in wall thickness everywhere but at the ends where it is needed to overcome the local reduction in strength caused by the heat of welding. The result is aluminum piping which weighs up to 40% less but provides equivalent design strength.





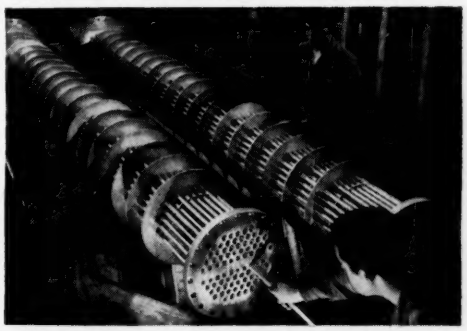
Alcoa UNITRACE® is the light, strong, corrosion resistant pipe which provides steam and product passages in a single extruded unit. It has proved an excellent way to cut cost and improve the efficiency of steam traced lines—by eliminating costly external steam jackets or inefficient tracer tubes. Now a new product,

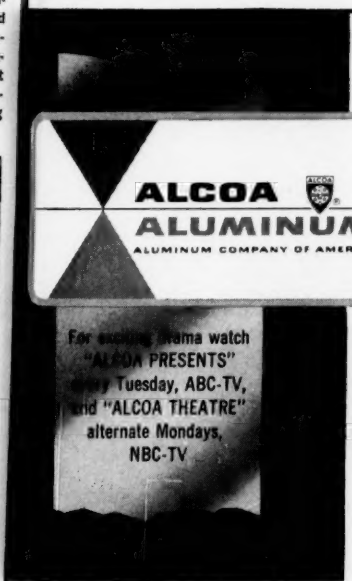
Alcoa DUOTRACE* makes possible the same important benefits in steam traced systems where recirculation is desirable. As shown, DUOTRACE provides two trace passages plus the product passage in one extruded unit. Flange and Trace Cap fittings compatible with conventional piping are available for both UNITRACE and DUOTRACE.

Design Note: Consider UNITRACE and DUOTRACE as low-cost successors to both heat exchangers and preheaters.

*Trademark of Aluminum Company of America

Alcoa Aluminum heat exchanger tubing is frequently the lowest cost material with suitable corrosion resistance for a variety of heat transfer applications. Moreover, aluminum frequently displays significant extra benefits—as in this pair of aluminum oil-to-oil exchanger bundles for preheating vegetable oils. Here, the aluminum alloys have no catalytic effect on the oxidation of the vegetable oil.





Aluminum Company of America, 871-F Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 10270 Alcoa Utilitube
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20265 Have You Tried Aluminum in Your Refinery?
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 20272 Aluminum Alloys for Handling High Purity Water
- ☐ 21090 Resistance of Aluminum Alloys to Fresh Waters
- ☐ 10130 Forming Alcoa Aluminum
- ☐ 19416 Brazing Alcoa Aluminum
- ☐ 19415 Welding Alcoa Aluminum
- ☐ 19051 Alcoa Aluminum Handbook

Name_____

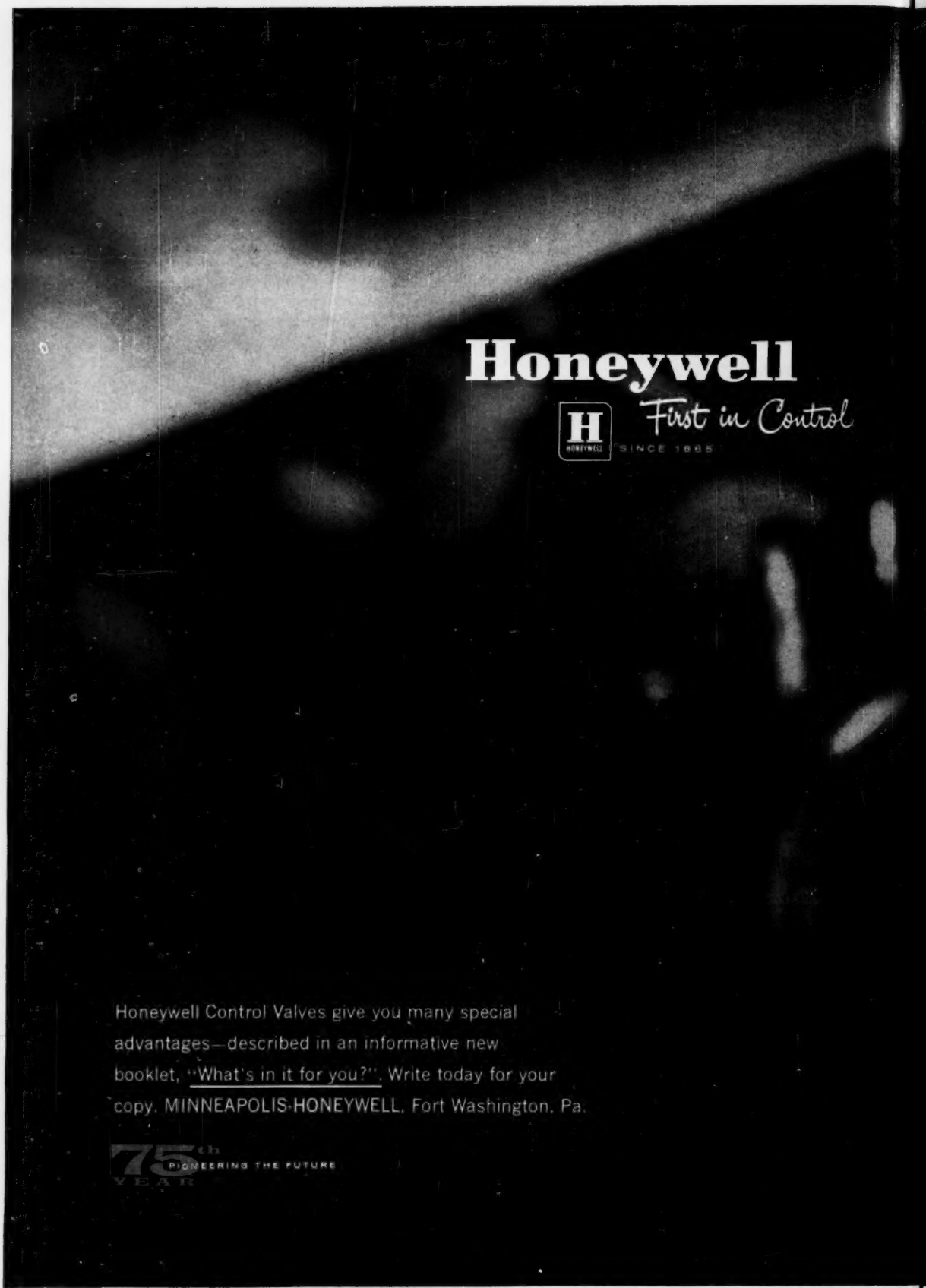
Company_____

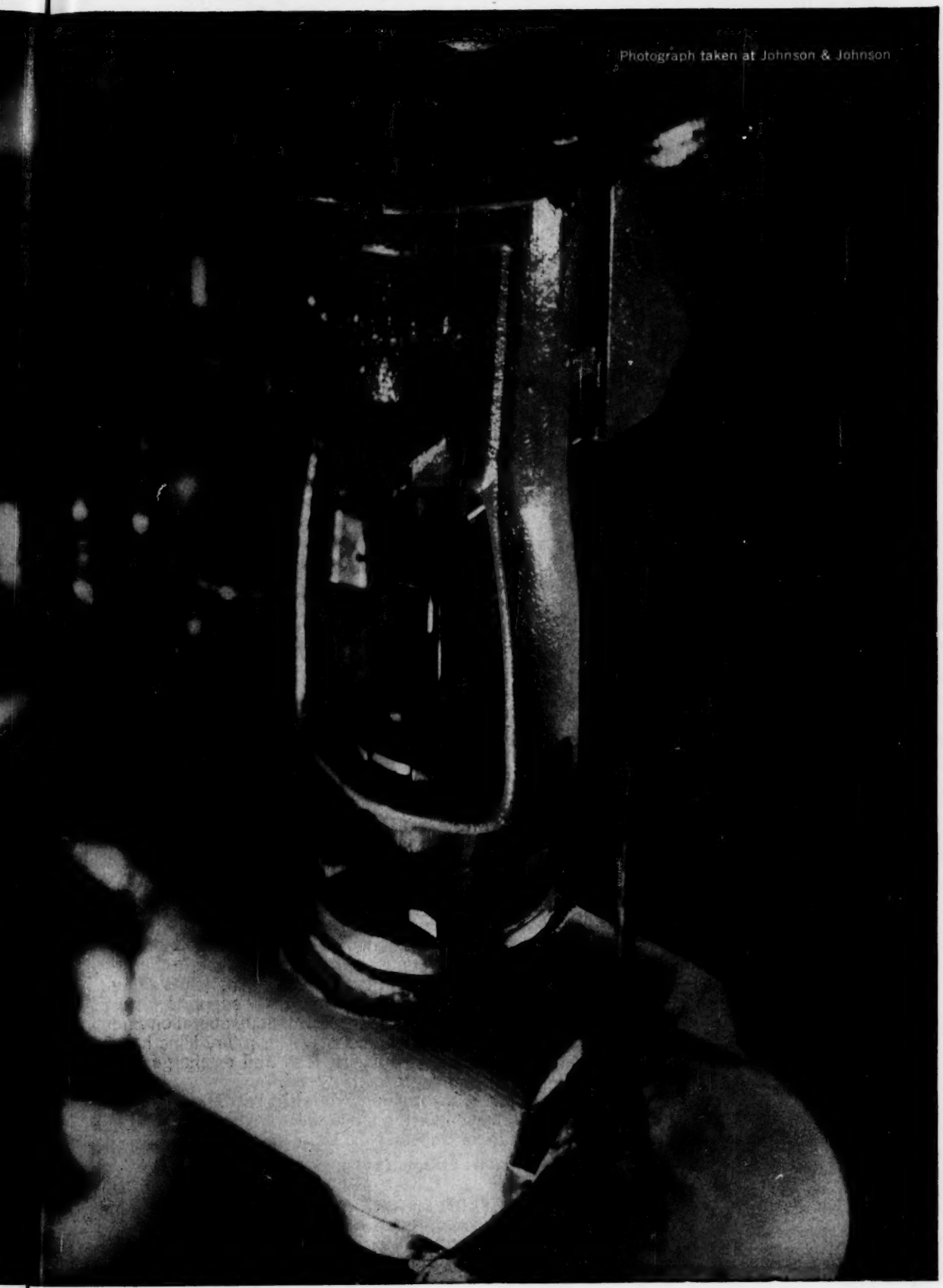
Title_____

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City_____

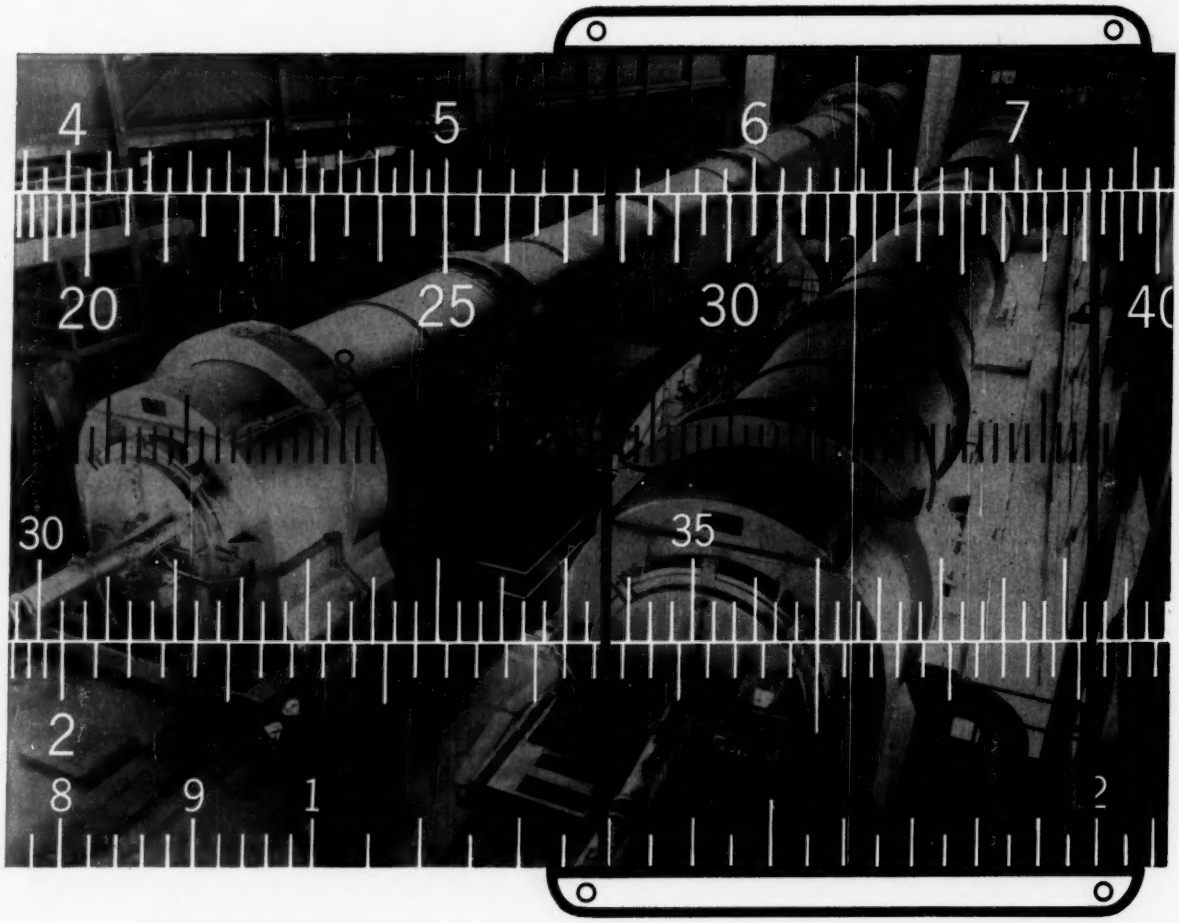
State_____


Honeywell
First in Control
SINCE 1885
Honeywell Control Valves give you many special advantages—described in an informative new booklet, "What's in it for you?". Write today for your copy. MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.
75th YEAR
PIONEERING THE FUTURE


Photograph taken at Johnson & Johnson

TRAYLOR PRECISION

from design through installation to operation



Shown above are two* 11′-3″ x 300′ dry process Traylor kilns designed to meet the specific needs of the Lone Star Cement Plant in Nazareth, Pennsylvania. These modern rotary kilns feature full-floating type roller ring and roller supports which insure easy alignment, continuous operation and low maintenance costs. Traylor rotary kilns have all welded steel shells, feed and discharge end seals and improved kiln feed.

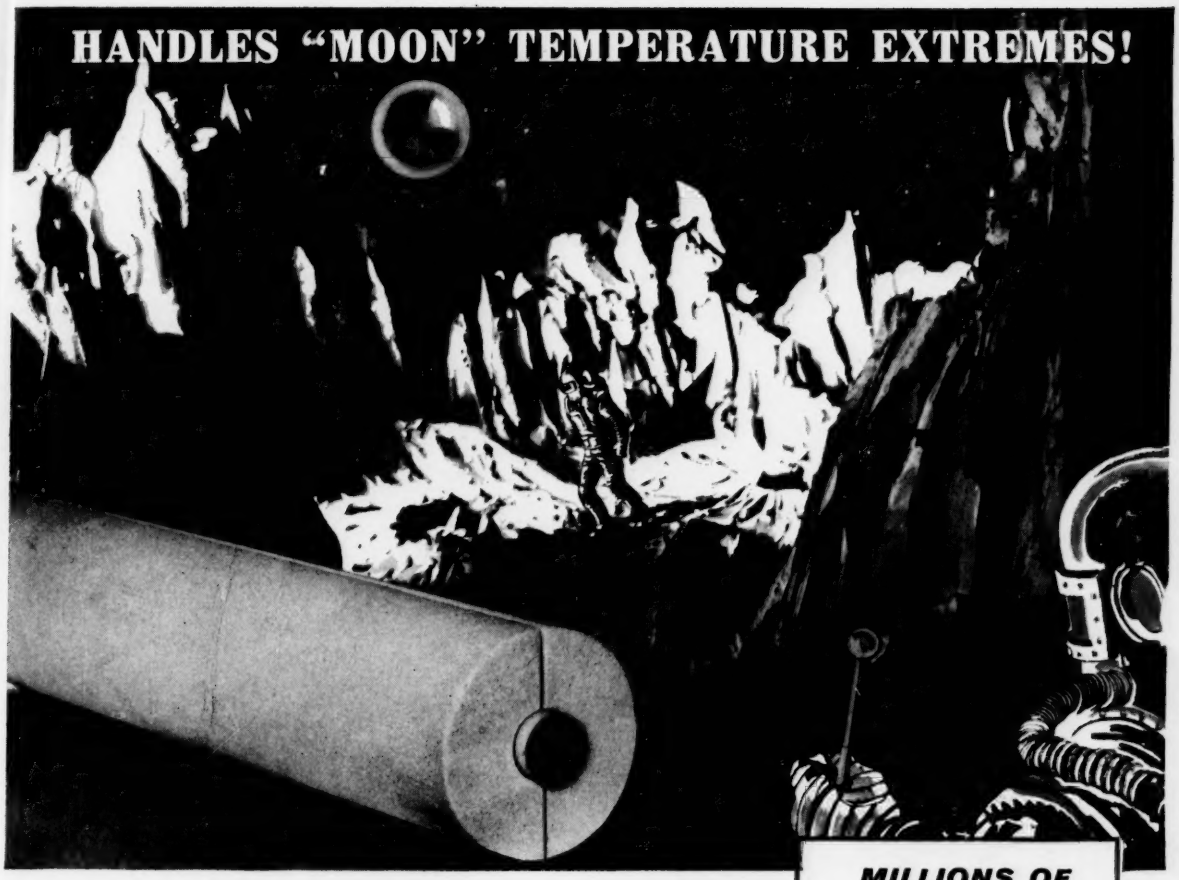
Write today outlining your kiln requirements and let our engineers make recommendations . . . or write for Bulletin No. 1115.

*Shown in the background are two additional Traylor Kilns, 11′-3″ x 270′.

TRAYLOR ENGINEERING & MANUFACTURING
DIVISION OF FULLER COMPANY
1570 MILL ST., ALLENTOWN, PA.
Sales Offices: New York, Chicago, San Francisco
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.

TKA-7

HANDLES "MOON" TEMPERATURE EXTREMES!



New low temperature insulation handles jobs in − 300° F. to + 220° F. range

Of course, this new Unarco U200 insulation is not in use on the moon . . . but it could be, because it handles temperature extremes even greater than would be required on this bleak island in space.* What's more U200 does it without thermal shock effects anywhere along the line.

A new, extremely lightweight, closed cell synthetic, U200 has excellent heat and chemical resistance. Its K factor is only 0.14 at 70° F. mean temperature . . . lowest on the market. Density is only 2.3 lb. per cubic foot. Yet this remarkable, new material has high compressive and flexural strength. It's non-toxic and easy to handle, too.

Try it just once and you'll see how quickly and easily it can be cut and applied with a very minimum of standard hand tools. It can actually reduce application costs by as much as 50%.

Available in accurate, half-round sections; in nominal thicknesses and in standard pipe sizes. Individual sections 36 inches long. Also available in 12″ x 36″ block form—1″ to 5″ thickness in ½″ increments.

(*) *−243° F. to +214° F. Estimated moon temperatures as listed in a leading American encyclopedia.*

Get complete engineering specifications and other details before another day goes by.

Write today on your company letterhead for Unarco Bulletin No. U200-1.

MILLIONS OF CLOSED CELLS MAKE U-200

- **Waterproof**
- **Vapor Resistant**
- **Efficient**
- **Lightweight**
- **Easy to Handle**

*Closed cell content of 85% plus.

U-200 *The insulation with "Handleability"*

POLYURETHANE FOAM

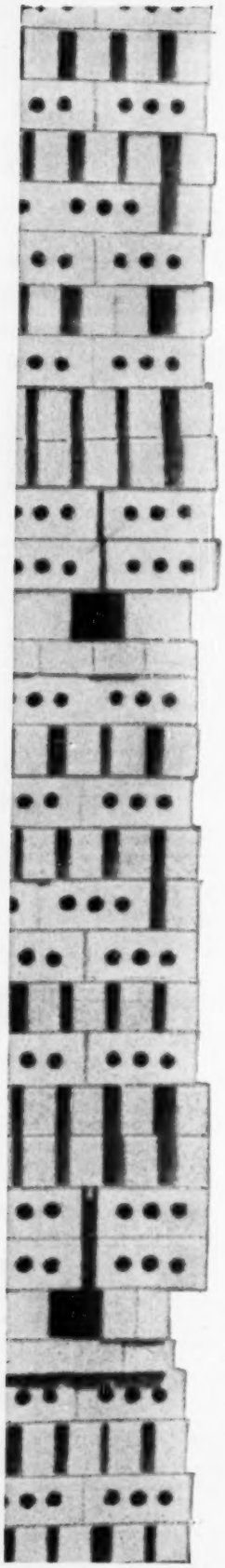
UNARCO ®

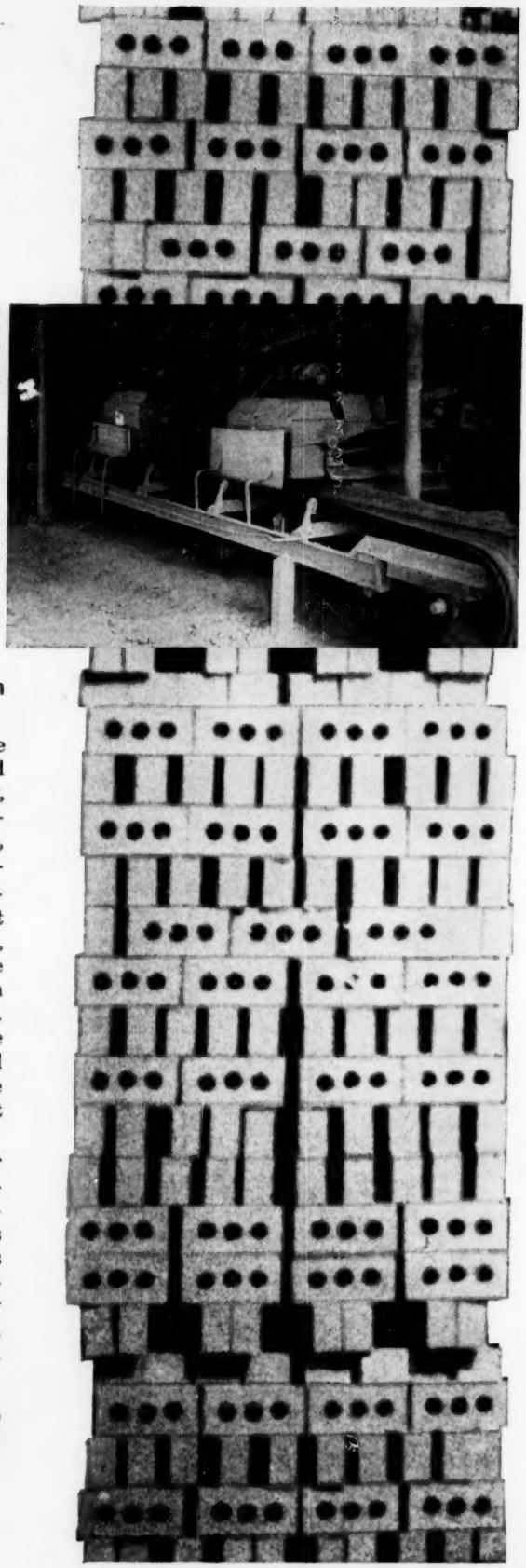
UNARCO PRODUCTS

• UNIBESTOS, Amosite Asbestos Pipe Covering and Block • Calcium Silicate Pipe Covering and Block • 85% Magnesia Pipe Covering and Block • Mineral Fiber Block • Wrap-On Insulation • Lace-On Insulation • Turbine Blankets • Insulating and Finishing Cements • Asbestos Textiles • Packing and Gasketing.

UNION ASBESTOS & RUBBER COMPANY

Fibrous Products Division • **Dept. 256, Bloomington, Illinois.**





Controls are set and these Waytrols proportion materials onto the make-up belt at a constant rate throughout a run.

"BECAUSE WAYTROLS CONTROL OUR MIX,

Brick size, colors and texture run the same month after month"

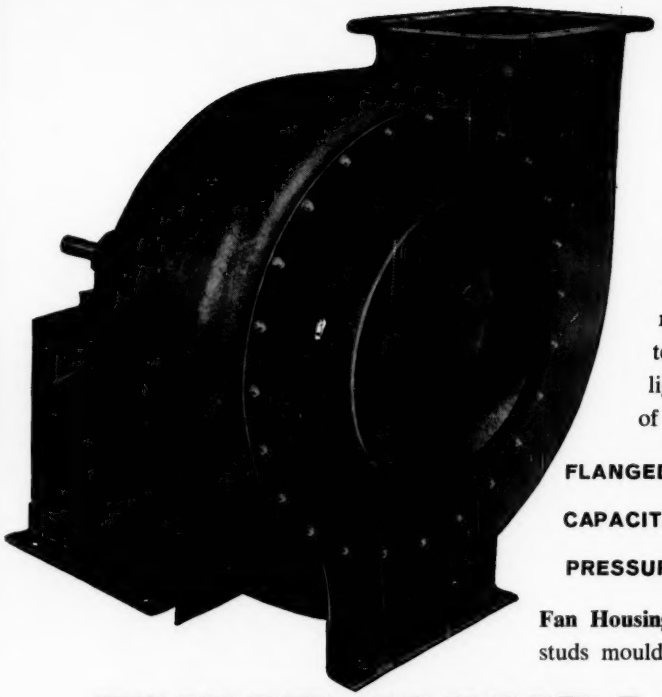
Building bricks by the millions are produced in the highly automated plant of Payne Brick Company, Elgin, Texas. Colors, size and texture are duplicated by accurate, continuous proportioning of materials going into their make-up.

Jeffrey WAYTROLS® handle that proportioning – weigh-feed shale, red clay and calcined clay at the head of the conveyor, add barium carbonate later to kill scumming. Because of the accuracy of the Waytrol, no excess barium need be added to assure an adequate quantity; sizable savings result from avoiding this waste.

Waytrols will save on labor where you're doing manual measuring or weighing, and by changing from batch to continuous feeding. Catalog 941 describes this automatic weigh-feeding equipment. For a copy, write The Jeffrey Manufacturing Company, 909 N. Fourth Street, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT...TRANSMISSION MACHINERY ...CONTRACT MANUFACTURING



A BUFFALO RESIN-BONDED FIBER GLASS FAN MAY BE YOUR ECONOMICAL ANSWER

Excellent chemical resistance to a wide range of acids, salts, gases, organic materials and other corrosives — strength and resilience — ability to stand temperatures up to 300°F. with special resins — and light weight are some of the desirable characteristics of the 'Buffalo' Type FG Fan.

FLANGED INLET AND OUTLET—for gas-tight connections.

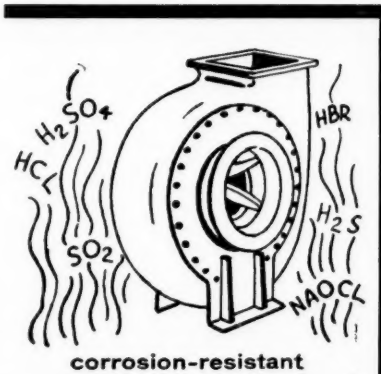
CAPACITIES — up to 34,000 cfm.

PRESSURES — up to 10″ static.

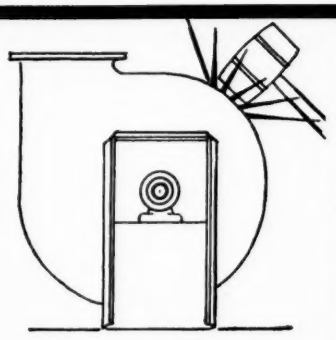
Fan Housing — resin-bonded fiber glass with stainless steel studs moulded-in for mounting to the bearing stand flange. Efficient scroll shape.

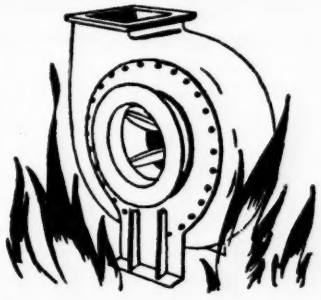
Rotor — husky steel wheel completely encased in resin-bonded fiber glass. Factory-balanced, statically and dynamically, for vibrationless performance.

FUME-HANDLING PROBLEM?



corrosion-resistant


impact-resistant


won't support combustion

WRITE FOR BULLETIN FI-511 for all details and chemical resistance table.

"Buffalo"

BUFFALO FORGE COMPANY

Buffalo, New York

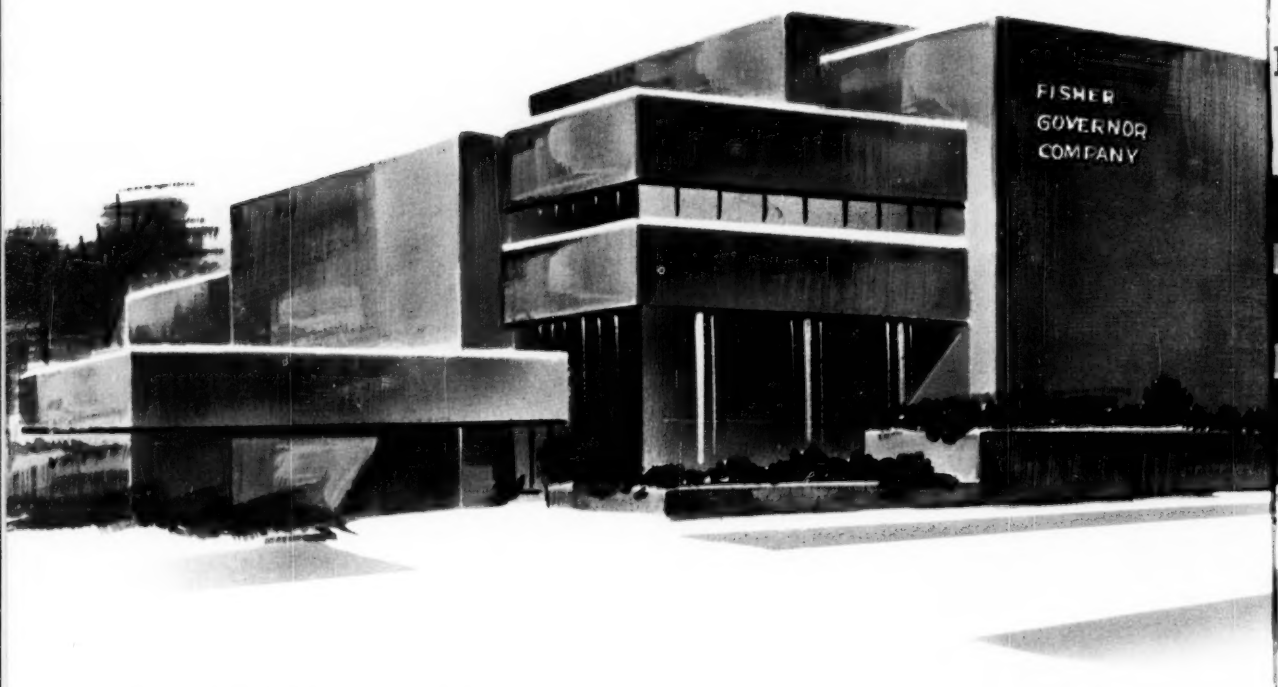

Buffalo air handling equipment to move, heat, cool, dehumidify and clean air and other gases.


Buffalo Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.


Buffalo Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.


Squier machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

FISHER.... *an unparalleled*



Standing firmly behind every Fisher product is the "know-how" and motivating spirit that has guided the Fisher organization since 1880. These, combined with the remarkable engineering and manufacturing facilities illustrated and described here, have made possible the slogan: "If it flows through pipe anywhere in the world... chances are it's controlled by FISHER."

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.



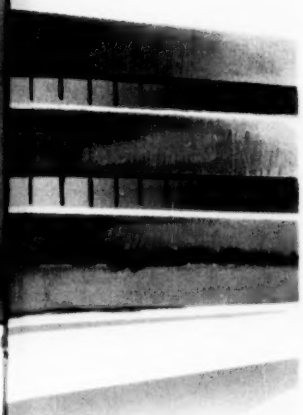
CONTINUOUS ADVANCED RESEARCH
Increasingly severe service conditions are encountered daily in the fields of nuclear power and cryogenics. To meet these conditions, Fisher research maintains a continuous program for development and use of new metals and materials.

PRACTICAL DESIGN ENGINEERING
Design engineering at Fisher is always aimed at solving industry's flow control problems, practically and efficiently. Over 80 years of development and improvement has resulted in a full line of controls of proven durability and performance.

TESTING AND DEVELOPMENT
Representative of the very latest and finest in equipment, that aids Fisher engineers in the development of new and improved products, is the recent addition of a test line that is capable of handling pressures up to 2500 psi, air or water.

engineering and manufacturing facility

....to build better
PRESSURE AND LIQUID LEVEL CONTROLLERS





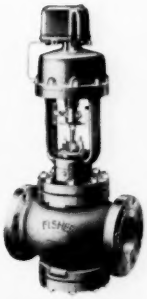
Type 657-A
Diaphragm
Control Valve



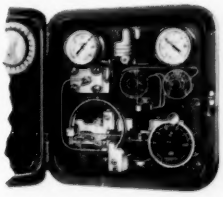
Type 2500-249
Level-Trol



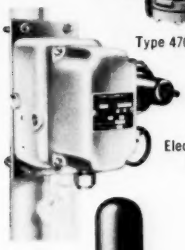
Series S100
Gas Service
Regulator



Type 470 P.O.P.



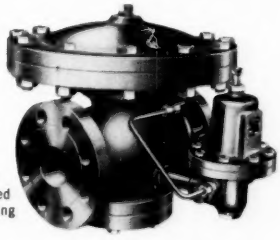
Wizard II
Pressure Controller



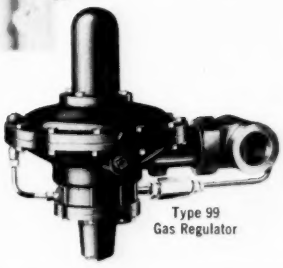
Type 543
Electro-Pneumatic
Transducer



Type 350
Electro-Hydraulic
Control Valve



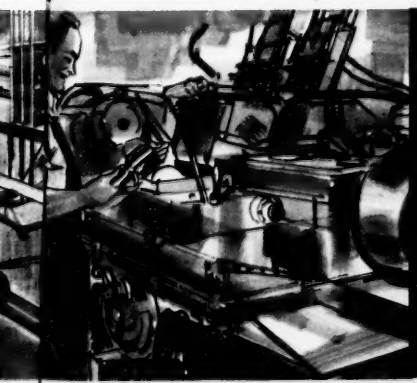
Type 92-B
Pilot-Operated
Steam Reducing
Valve



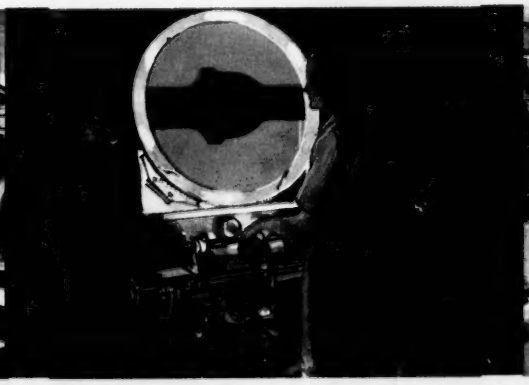
Type 99
Gas Regulator

FISHER® Controls

SINCE 1880



LATEST PRODUCTION METHODS
Various new style grinders produce a super-finish on Fisher valve guides and bushings, second to none in the industry. It is typical of precision manufacturing methods that assure long, trouble-free operation of Fisher controls in the field.

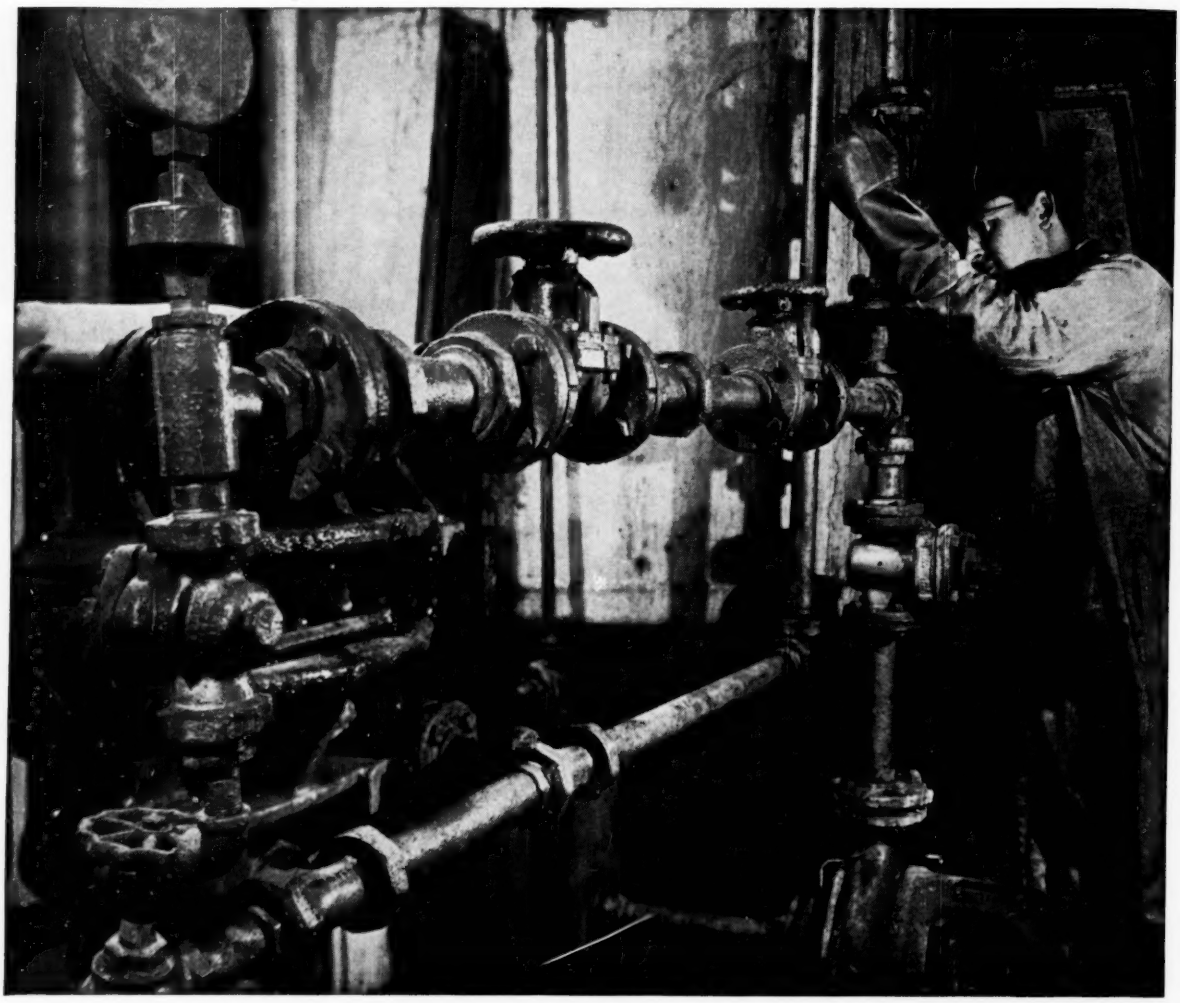


RIGID INSPECTION PROCEDURES
The highest ratio of inspection personnel to production personnel, in the control valve industry, is maintained at Fisher. As a typical example, there are no less than 704 inspection operations performed on a 4" Type 657-A diaphragm motor valve.



EFFICIENT FIELD SERVICE
"Supermarket" 36-hour delivery, from the factory, on popular sizes and types of controls is only one of many services available to Fisher customers. 17 sales offices throughout the country maintain field stocks for immediate delivery.

DOW | SARAN LINED PIPE



After eight years carrying lithium chloride brine . . . No Corrosion in Saran Lined Pipe

When pipe must carry extremely corrosive lithium chloride brine . . . when floor-level installation freely exposes it to danger of accidental damage from trucks and tools . . . doubly protective Saran Lined Pipe can mean dependable, low-maintenance operation for many years.

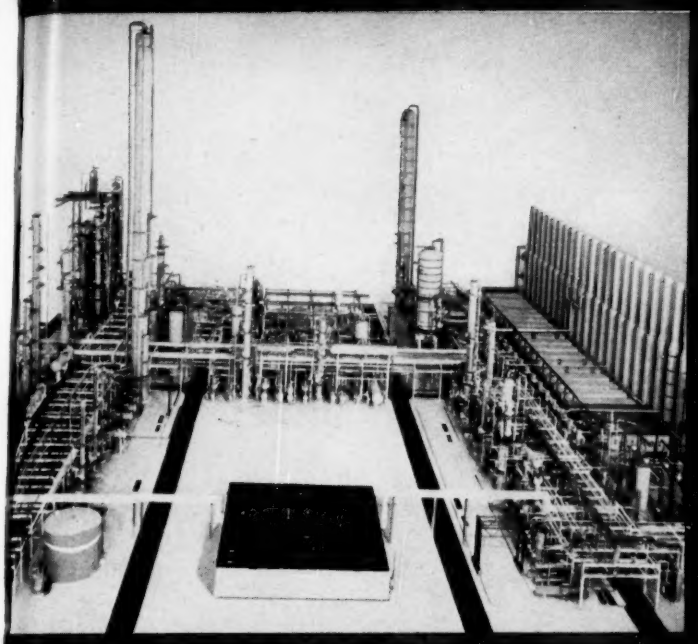
Lithium Corporation of America's Minneapolis, Minnesota, plant produces pure lithium metal as well as various lithium salts. In the production of lithium chloride, Saran Lined Pipe is used to carry LiCl brine to drying equipment for the removal of water. This brine is extremely corrosive and will quickly eat through steel pipe should a crack develop in the lining. Other Saran Lined Pipe carries suspensions of lithium fluoride and hydrofluoric acid, a combination which will attack and destroy even glass. Because of its strength and extreme corrosion resistance, there's never been a failure in the Saran Lined Pipe.

Saran Lined Pipe at this plant is installed close to floor level in some working areas, constantly exposed to the danger of accidental damage from trucks and tools. Lithium's engineers stated, "Saran Lined Pipe provides protection from outside damage and from corrosion by the solutions carried. In eight years of pumping LiCl brine through Saran Lined Pipe at 30 to 50 psi, there's never been a breakdown, and very little maintenance was required."

Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field, without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1780-AK6-27.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

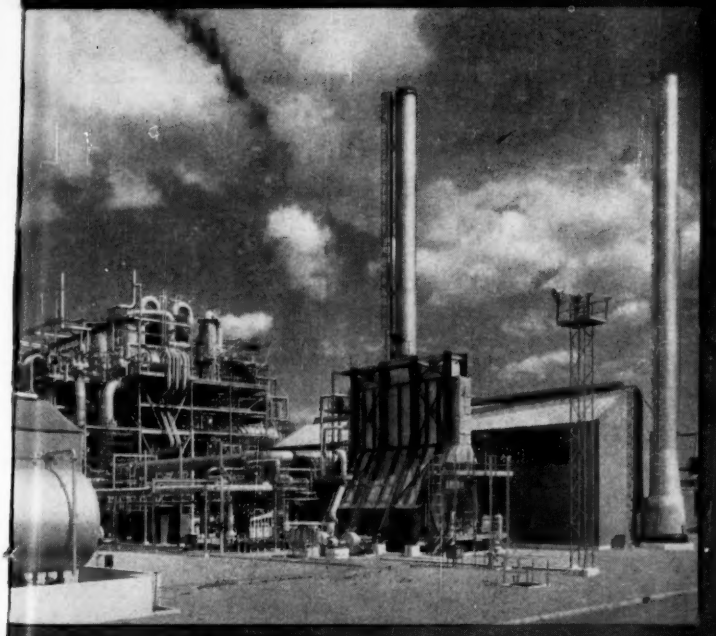
Kellogg Engineers and Builds World's Biggest Olefin Plants



Mobil

FUTURE WORLD'S LARGEST is Socony Mobil Oil Company's ethylene plant at Beaumont, Texas. It is the first large plant in the U.S. to crack naphtha into olefins. Engineered by The M. W. Kellogg Company, as shown in this scale model, it is scheduled for completion by Kellogg by 1961. Capacity will be 380 million pounds annually of 99.9% purity ethylene.

This newest plant consists of steam pyrolysis, gas treating, and product recovery sections. It has been designed to handle simultaneously both liquid and gaseous feedstocks. In addition to ethylene, major products will include propylene, propane, a B-B product, gasoline, and fuel oil.



ICI

LARGEST OUTSIDE THE U.S. is the English Wilton Works of Imperial Chemical Industries, which now includes three olefin plants. Photograph shows Plant No. 3. All are the result of close engineering cooperation between Kellogg and I.C.I. Together, they represent a current output of 110,000 tons per year of high-purity ethylene, and a potential of 140,000 tons.

Plant No. 1, commissioned in 1951, was the first full-scale adoption of the then novel process of oil pyrolysis developed in Kellogg's laboratories. Its success led to the addition of Plant No. 2 in 1956, and then to No. 3—representing a 60% increase in olefin capacity—in 1959.

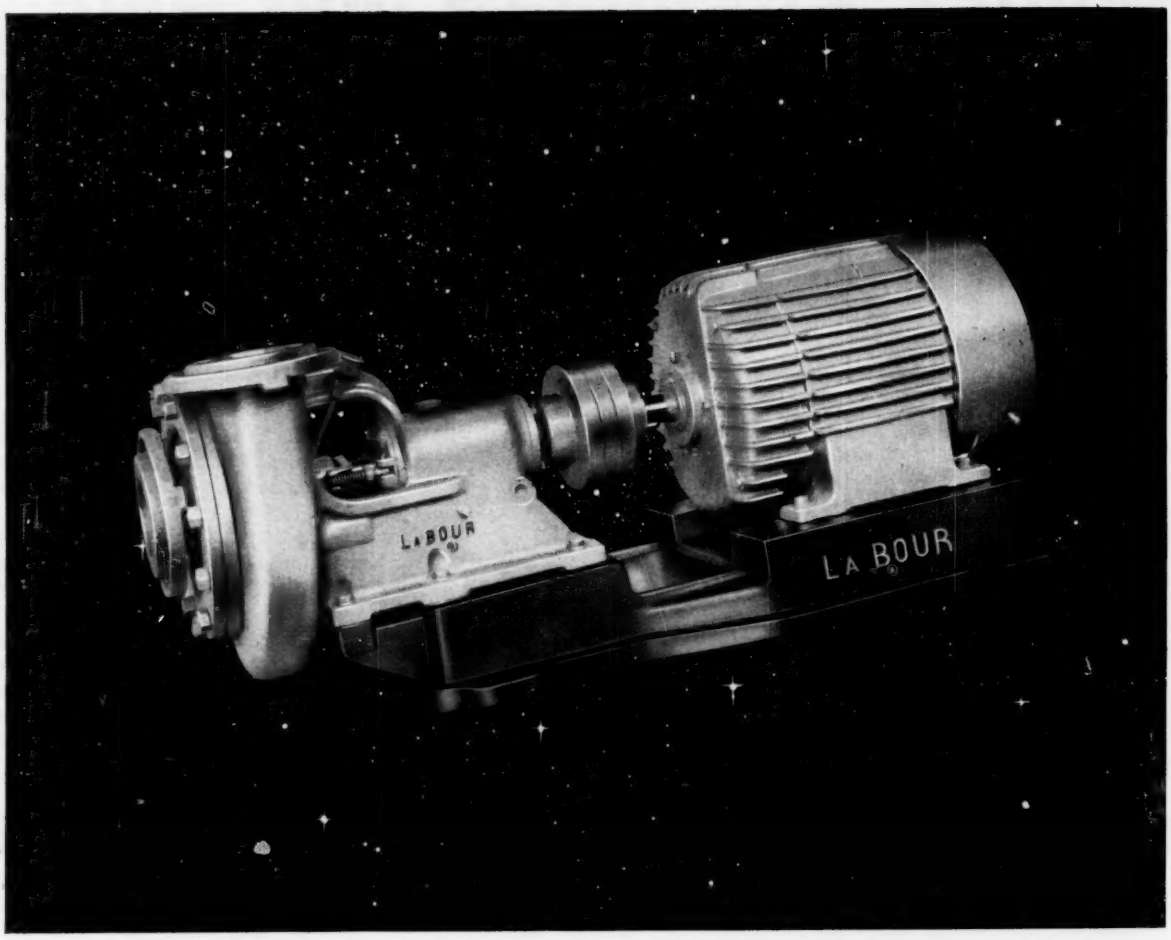
Whether your approach to ethylene is through the steam pyrolysis of hydrocarbons or the recovery of ethylene from gas mixtures, Kellogg has developed processes which can assure the optimum investment, operating costs, product purity, and yield. For more information about Kellogg's 2-billion-pound background in engineering and/or building ethylene plants, write for a copy of "Olefin Plants" Kelloggram.

M KELLOGG W

THE M. W. KELLOGG COMPANY

711 Third Ave., New York • Subsidiary of Pullman Incorporated

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires



The Pump that can *TAKE THE AIR!*

In most applications where self-priming pumps aren't needed there are occasional circumstances that bring air or gas to the pump along with the liquid. If you've specified a LaBour Type Q or SQ, when this happens the pump clears itself without stalling and goes on pumping.

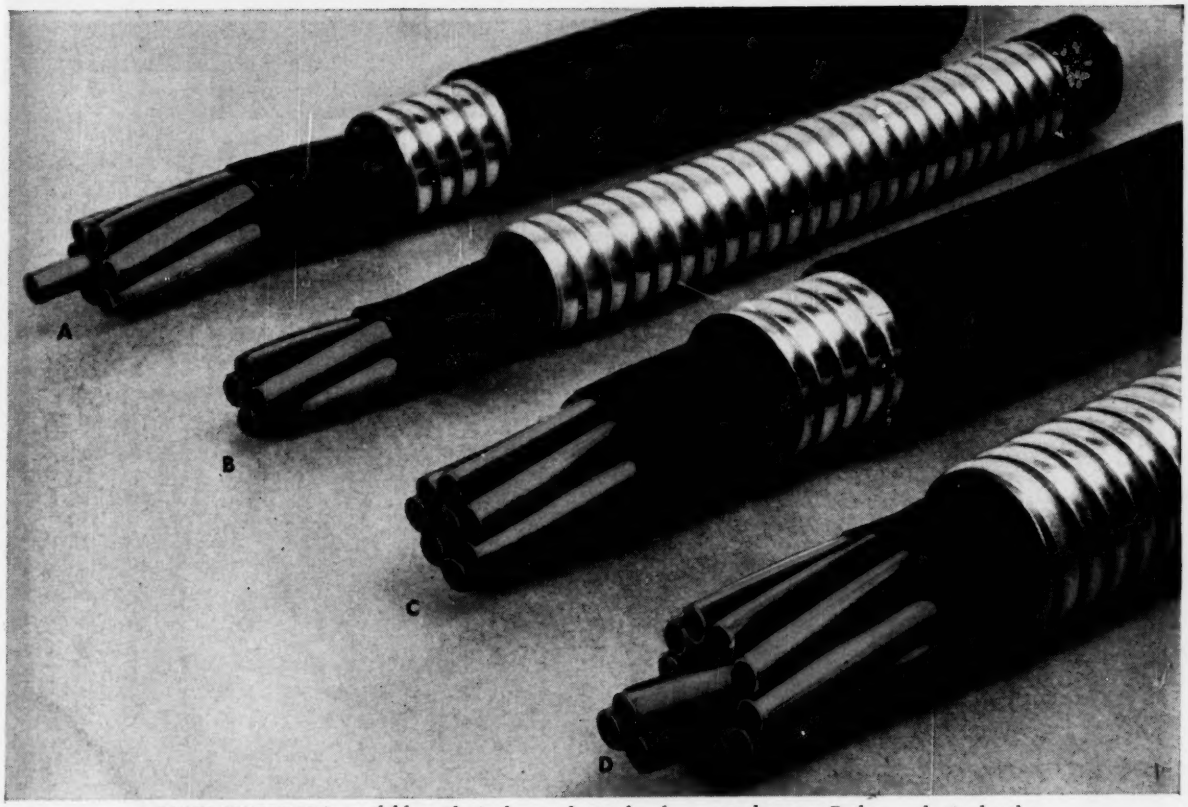
The ability of these LaBour pumps to handle considerable volumes of air or gas mixed with the liquid is a function of the open impellers in conjunction with proper casing design. Since the open impellers work without dependence upon close clearances, these pumps show little loss of efficiency after long wear and severe service has increased original clearances manyfold.

Get the facts about pump efficiency and other advantages of open impeller design as created by LaBour. We'll be glad to supply those facts.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

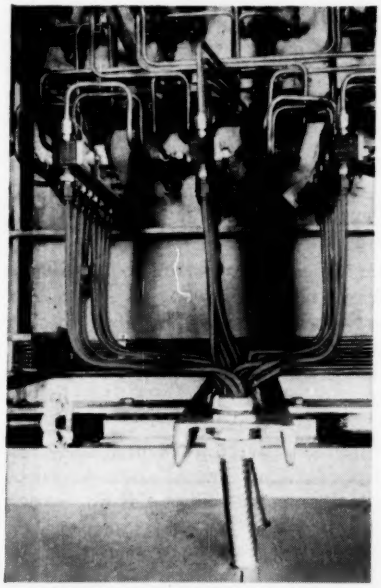
LABOUR

THE LaBOUR COMPANY, INC. • ELKHART, INDIANA, U. S. A.



BAILEY ARMORTUBE is available with *A*, thermoplastic sheath over steel armor; *B*, thermoplastic sheath under steel armor; *C*, thermoplastic sheath over and under steel armor; or *D*, with just steel armor.

For its "Armortube" control system cables, Bailey specifies Anaconda precision copper tube in long coils



A TYPICAL INSTALLATION of Bailey Armortube in a large utility, indicating the large number of separate lines carried by two easily installed cables.

Armortube® flexible, armored, multiple-tube cable made by Bailey Meter Company, Cleveland, Ohio, has saved up to 40% of single-tube installation and maintenance costs in pneumatic, metering and control systems.

Armortube cable is available in lengths up to 1000 feet and in bundles of up to 19 individual ¼" O.D. copper tubes. Steel interlocking armor protects the tubes from mechanical damage and simplifies installation. In addition, various combinations of thermoplastic sheathing are available to provide further protection from moisture and corrosive atmospheres during and after installation.

CLEAN AND DRY. The copper tubes must meet rigid quality specifications, and Bailey has found that Anaconda copper tube consistently meets its requirements. Anaconda takes special care to see that inside surfaces are clean, smooth, and bright—free from dust, dirt, or metal chips which might interfere with the operation of delicate air and hydraulic circuits. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE AND ACCURATE. Anaconda copper tubes are uniformly soft, highly flexible—for easy bending during installation. And they are accurate in size and shape.

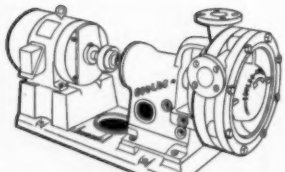
LONG LENGTHS. For applications such as instrumentation, Anaconda can produce copper tubing in coils up to 2200 feet for ¼" O.D.—up to 1400 feet for ⅜" O.D.—up to 1000 feet for ½" O.D.

QUALITY TUBE AND CREATIVE TECHNICAL SERVICES. Whatever your requirements for precision copper tubing—instrumentation or capillary tubing, or restrictor tubes – Anaconda specialists can help you find the most economical way to do the job. For such technical assistance, see your American Brass representative, or write: French Small Tube Division, The American Brass Company, Box 1031, Waterbury 20, Conn. 6069

ANACONDA®
INSTRUMENTATION TUBING



IS THIS HAPPENING INSIDE YOUR PUMPS?



The Goulds-Pfaudler glassed pump is available in conventional hydraulic design, simplifying installation and maintenance. Four sizes with capacities up to 700 GPM, heads up to 140 ft.

When you pump corrosives, the inside of your pump *can* look like this. Or . . .

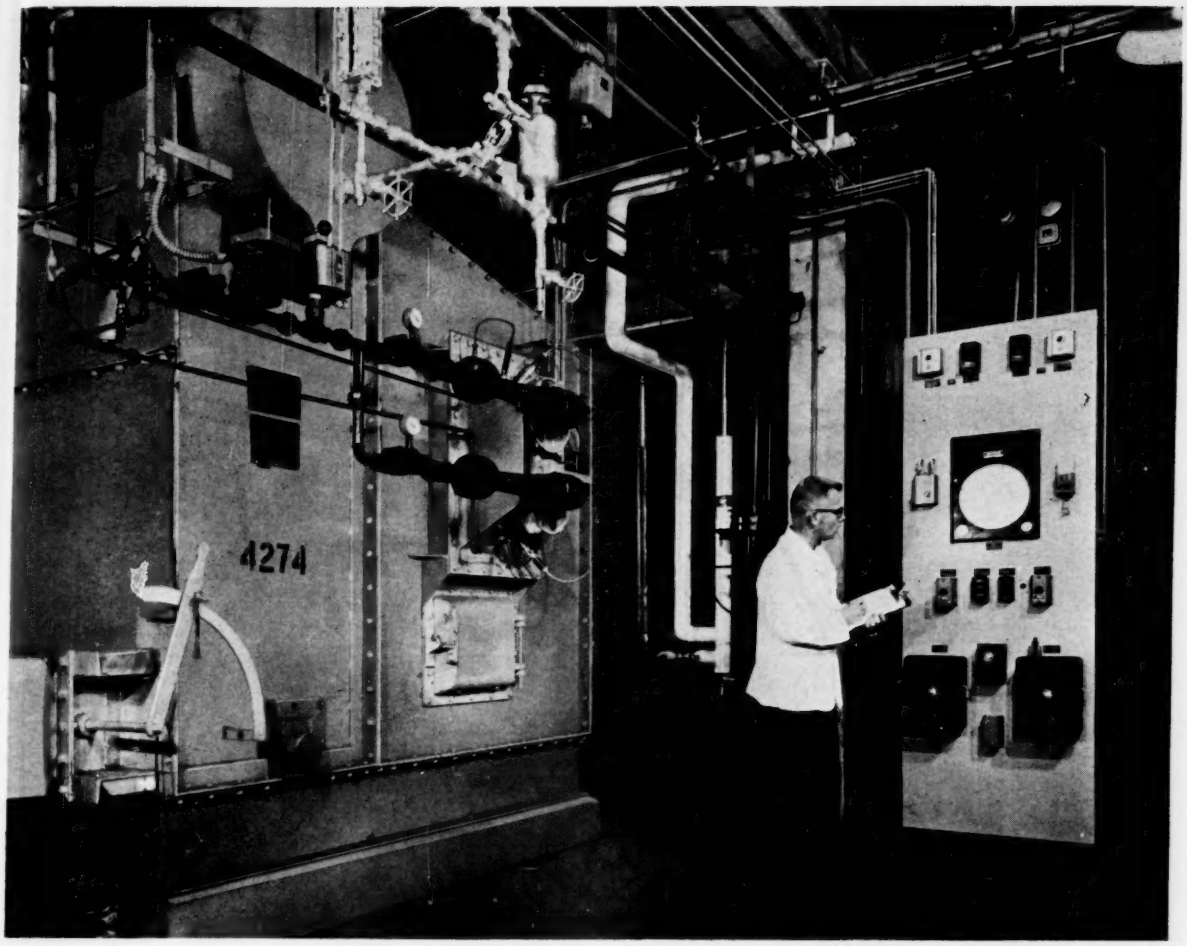
You can pump corrosives *without* corrosion with the Goulds-Pfaudler Fig. 3708 glassed pump. *Every surface that comes in contact with the pumpage* is protected by tough borosilicate glass fused permanently to the metal!

This glass-to-metal bond resists most acids at temperatures up to 350°F and alkalies at moderate temperatures.

You also prevent loss of product due to contamination, since glass is *inert*. Glass is *smooth* — discourages product adhesion and scale build-up.

For all the details, write for Bulletin 725.2 . . . plus a second booklet, "It's What's Inside That Counts," that gives you the inside story behind the new Goulds-Pfaudler glassed pump. Write Goulds Pumps Inc., Dept. CE-60, Seneca Falls, New York.

GOULDS GP PUMPS



2,250,000 Btu/hr vaporizer using Dowtherm at the Dow Corning Corporation.

PRECISE HIGH TEMPERATURES with COMPLETE SAFETY

NO open flame and NO high pressure steam

In the process industries, obtaining high temperatures without undesirable side effects is a year-round problem. Direct heating with an open flame or heating with high pressure steam often creates fire or explosion hazards. And where precise temperature control is important, they may also result in control difficulties and cost problems.

The answer to these problems is an FW high-temperature low-pressure vaporizer. FW has been designing and building them for 26 years and in that time has installed more than 700 organic process heating systems. Individual units range from 44,500 to 50,000,000 Btu/hr and operate at temperatures from 350 to 750 F at pressures from 1 to 113 psi.

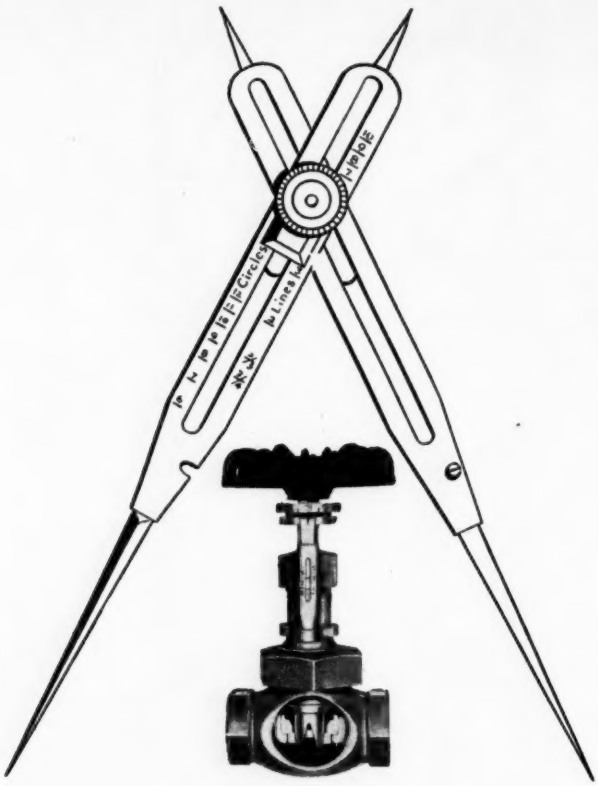
If you have process heating problems, remember that only Foster Wheeler does the complete job. The design of your entire heating system is analyzed to make sure that the application, piping arrangement, and thermal design are correct. And FW not only designs and builds the vaporizer, but also installs the unit and places it in service at top efficiency. In addition, FW engineers are available to work with your consultants and engineers to solve future problems concerned with process changes, relocation of equipment, and plant expansion.

For your high-temperature low-pressure heating problems draw on Foster Wheeler's long and varied experience with vaporizers and process facilities. Many of the outstanding process companies have done so . . . repeatedly. Write for Bulletin ID-54-5. Foster Wheeler Corporation, 666 Fifth Ave., New York 19, N.Y.

Heat Engineered products, plants and processes . . . for the world's petroleum, process and power industries.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.



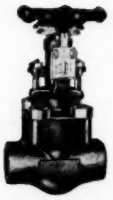
PROPORTIONER

controls flow to save for you

The V-port disc in all Hancock "Flocontrol" Valves insures proportional flow throughout the entire lift of the stem. They are valves that help you achieve uniform product quality through closer control, save steam and fuel on process work, and cut maintenance costs.

"3 in 1" valve design combines variable orifice with shut-off and micrometer dial and pointer. The valve opening can be set within 1/10 turn of the handwheel —you can duplicate all settings easily, instantly. No shut-off valve required—flow is in a straight line, with separate shut-off seating surface located away from the V-ports.

Hancock "Flocontrol" Valves are available in Bronze and Steel to meet the most demanding services. Ask your industrial supply distributor for details.



Hancock "Flocontrol" valves assure positive pinpoint control—eliminate all guesswork.

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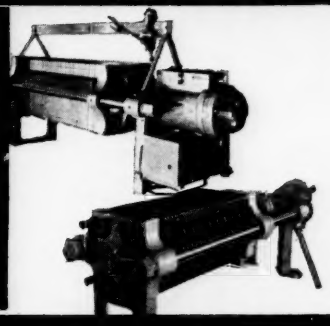
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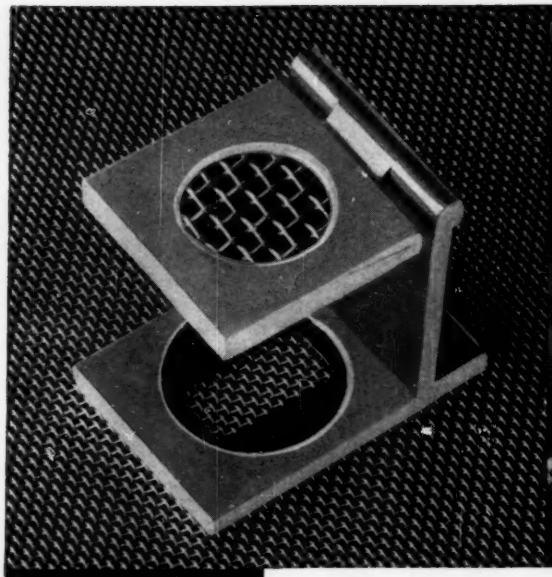
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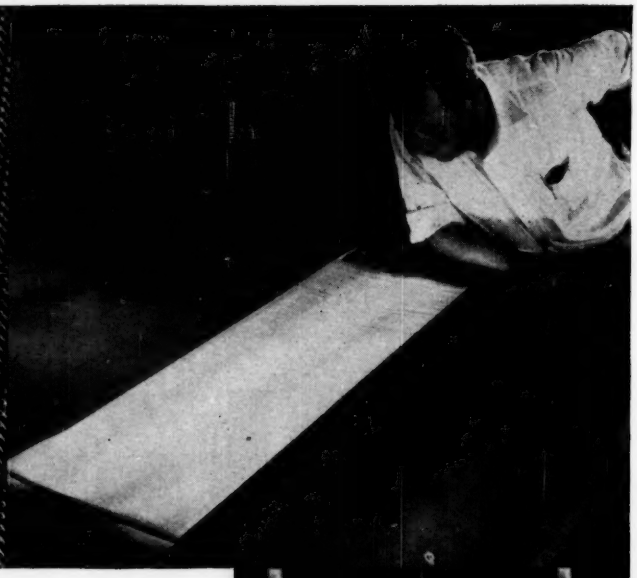
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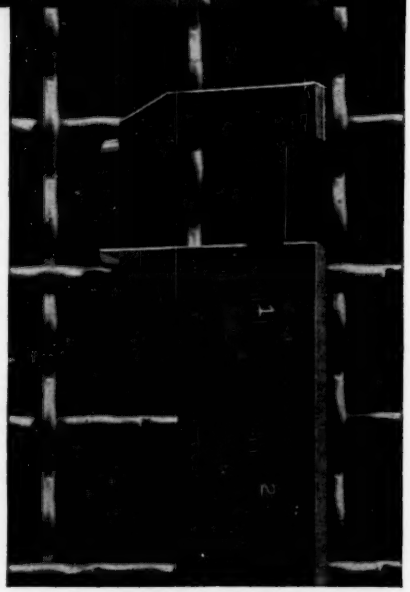
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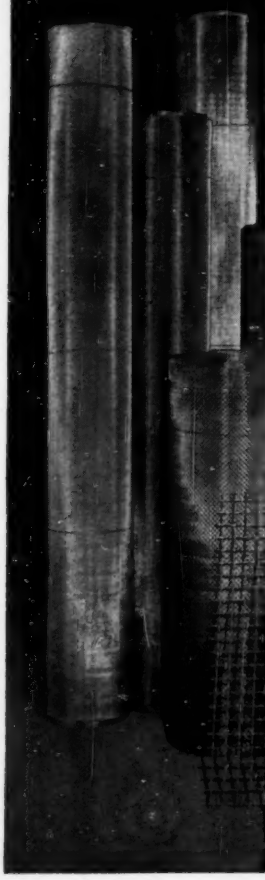
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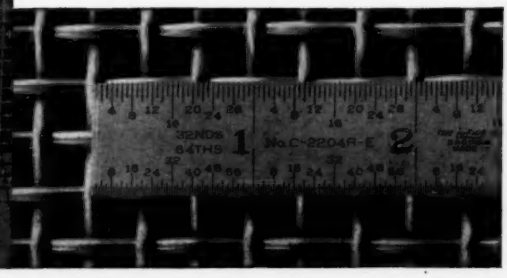
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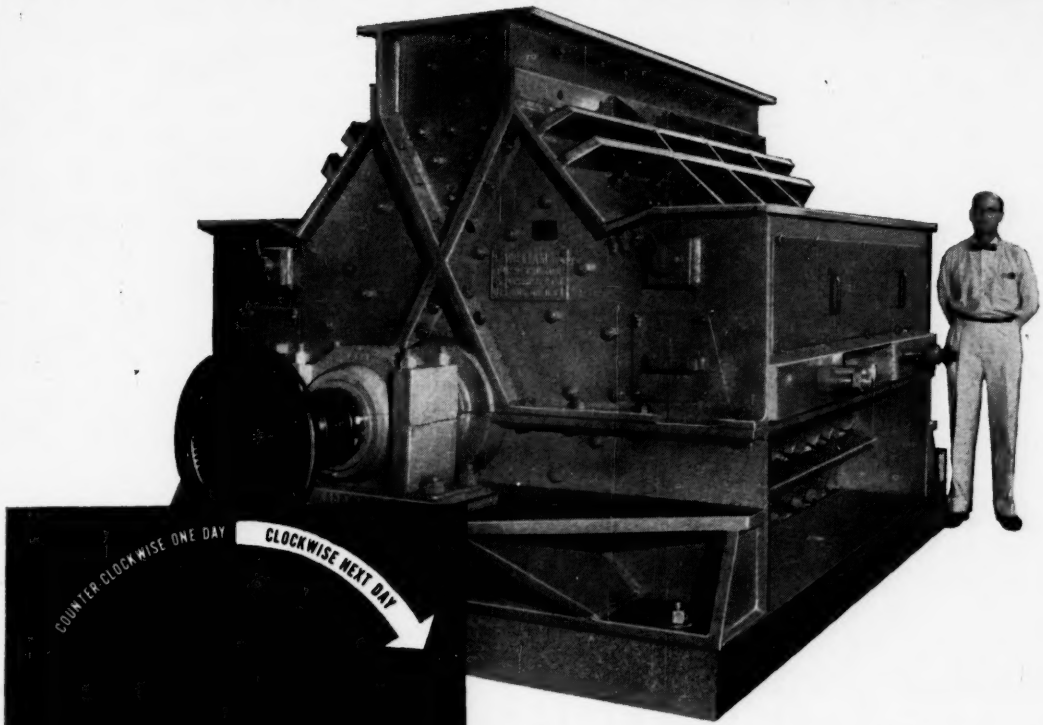








More efficient CRUSHING AT LOWEST COST for labor, power and upkeep with WILLIAMS REVERSIBLE IMPACTOR



REVERSIBLE ROTATION prolongs parts life without manual adjustment. A simple reversing switch on motor does it.

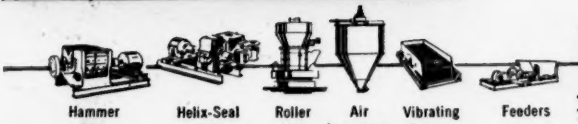
INTERIOR VIEW of small Impactor shows typical rugged hammers, impact blocks and liners made of manganese steel and other alloys. Rotor removable without disturbing feed or other mechanisms.

For secondary crushing, the economy and high production of a Williams Reversible Impactor is unequalled, whether raw material is hard and abrasive or soft and friable. Precision control of specified top-size is easy, usually in a closed circuit system, from a coarse 2" with minimum fines, down to 35 mesh or finer.

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Reversible rotation is a prime feature of the Williams. So is *Wide Open Accessibility* to interior. So are the *Interchangeable Impact Blocks* to balance wear. So are the many other exclusives that hold cost-per-ton to the very lowest. There is a size and model for your exact needs. *Write for catalog.*

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F-M ADAPT-*ABLES* consist of a pump frame and simple adapter to which can be attached a wide variety of F-M hydraulic ends with enclosed, semi-open or non-clog impellers. Conversion is easy . . . inexpensive, too.

F-M ADAPT-*ABLES are "NEMA-Matched"*: pump mounting dimensions are standardized with similar dimensions of Nema-driving motors. Gone is the need for make-shift height-adjusting blocks and odd-bore couplings!

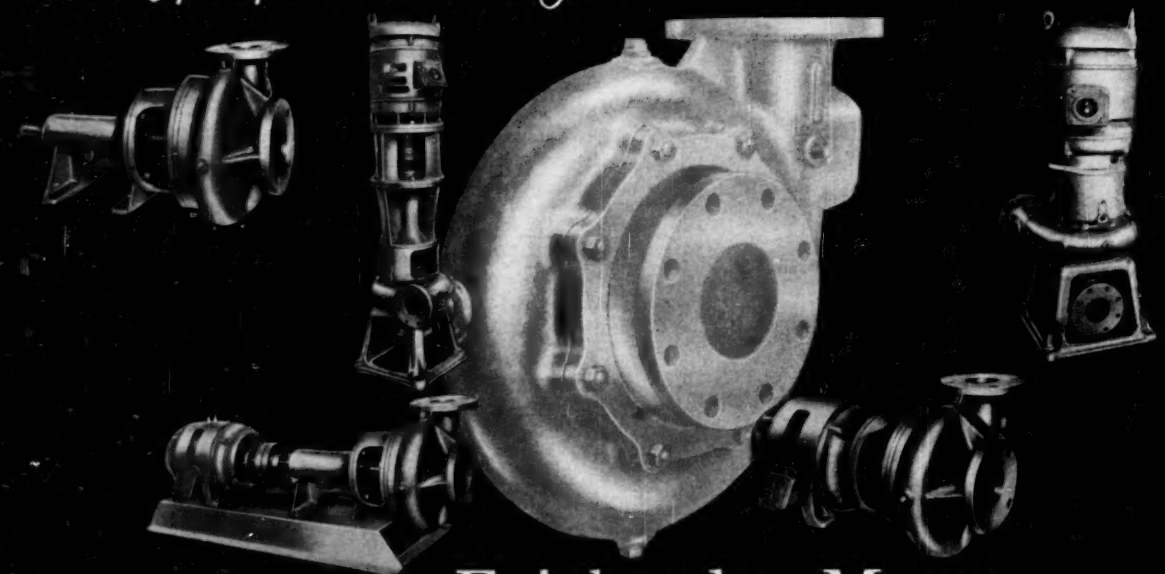
The ADAPT-*ABLE* design means that the most economical frame size may be selected to match the motor horsepower requirements of the pumping job.

And there are other advantages: choice of mechanical seals or conventional stuffing boxes with easy field changeover from one to the other . . . interchangeable bearings for pumps and motors. For special liquid handling problems, hydraulic ends can be specially alloyed to fit the needs: we've been solving such problems for generations.

Regardless of *what* liquids you pump . . . or *where* . . . Fairbanks, Morse builds pumps and *matching* power units for *your* use . . . in a greater range of sizes, types and capacities than *anyone, anywhere*. Start SAVING pump and motor dollars by putting F-M's vast hydraulic experience to work in your plants, process lines and products . . . now!

"nema-matched" *adapt-ables*

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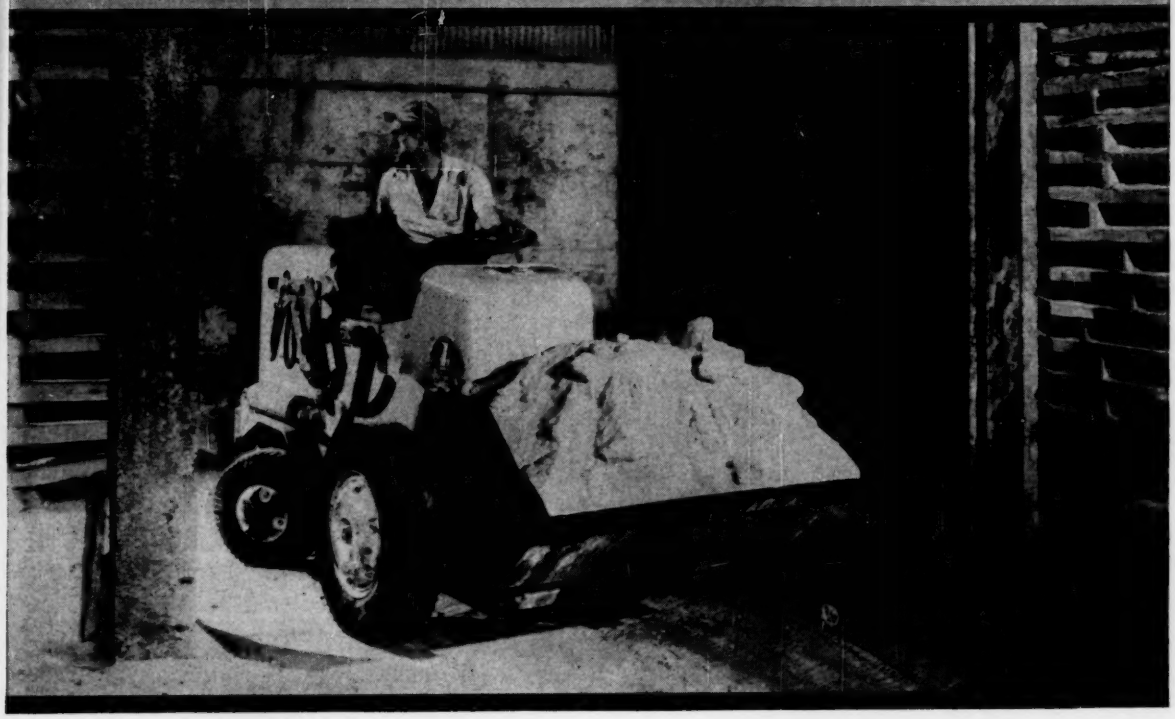
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THE OVERWHELMING CHOICE



10,000 "HA" units

More than 10,000 of this Model HA "PAYLOADER" have been sold to foundries, fertilizer and chemical plants and to other industrial users — more than any other rubber-tired tractor-shovel.

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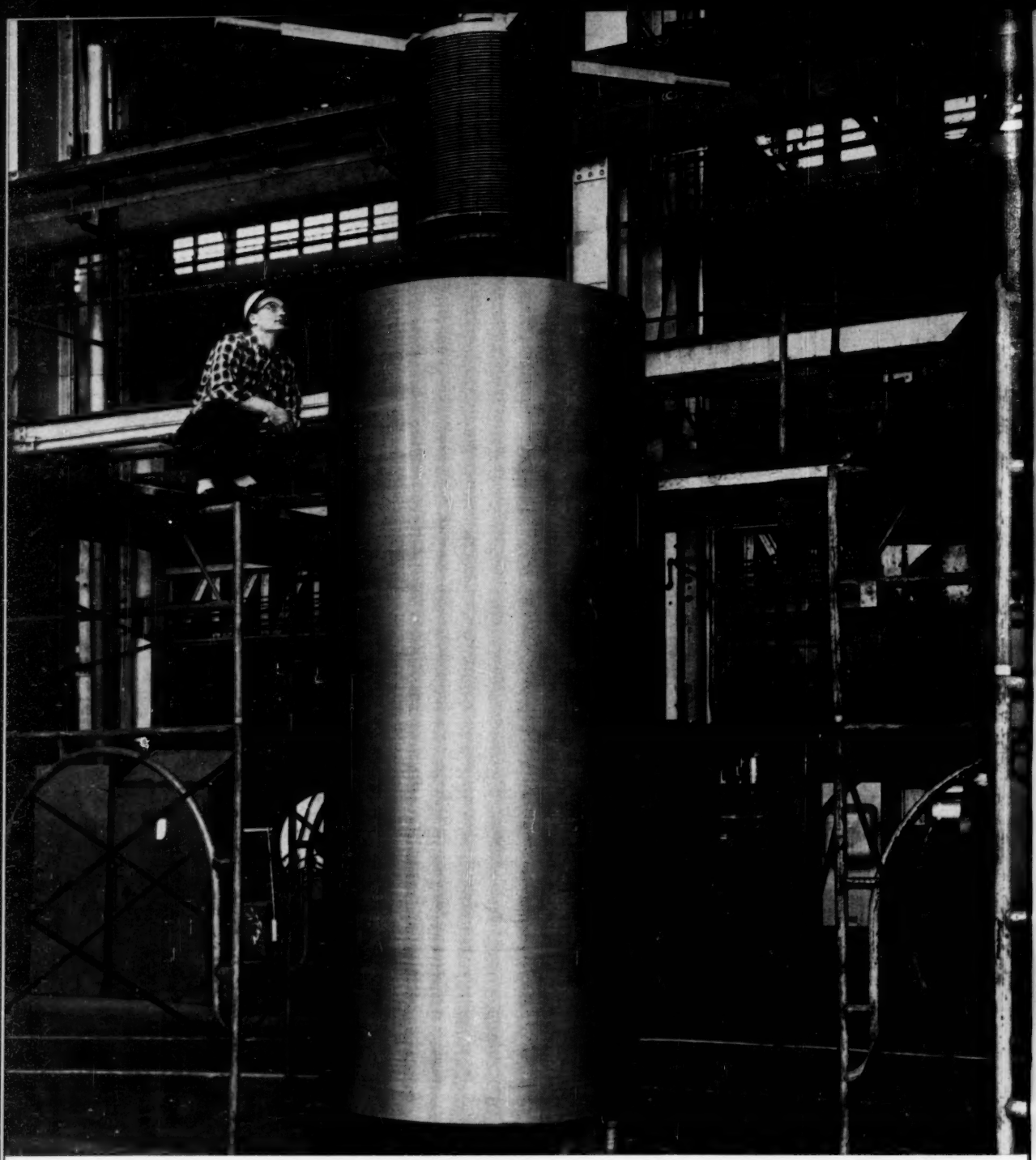
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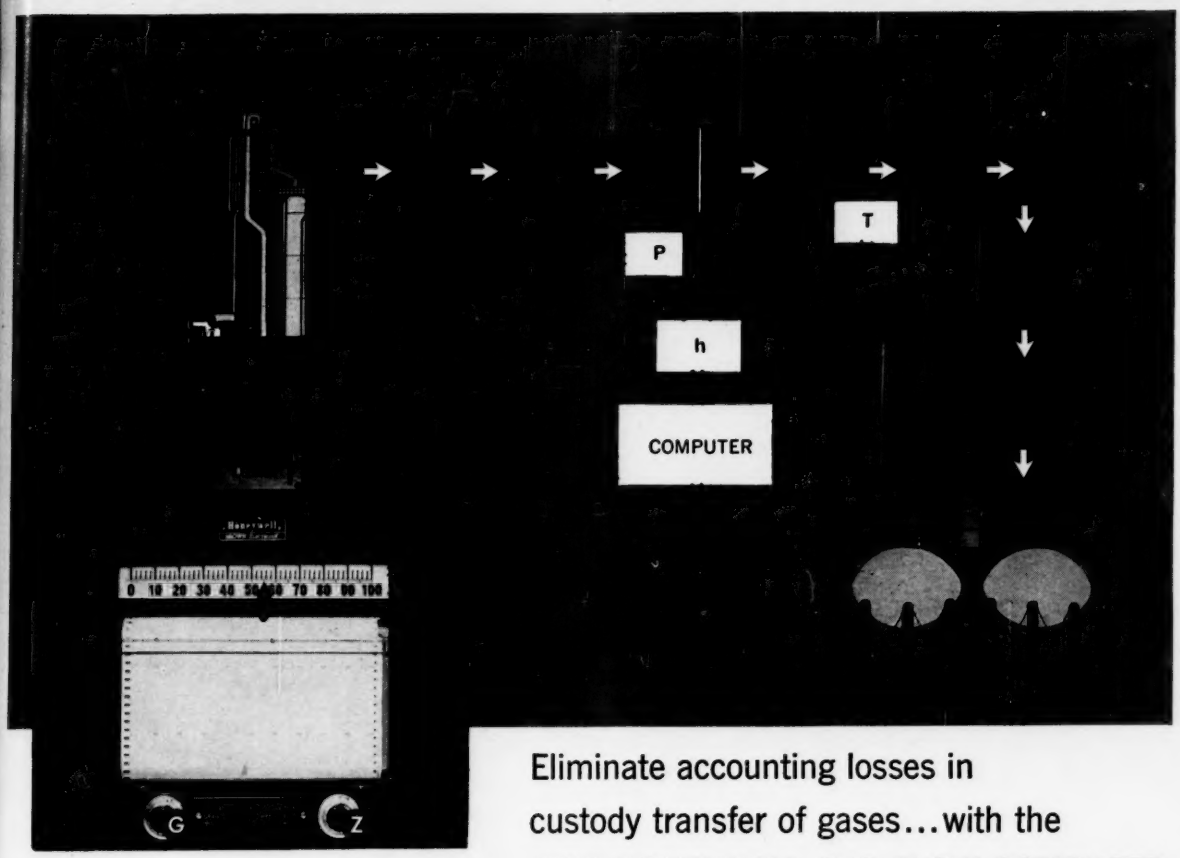
Hydrostatically tested in excess of 70,000 psi. This Bethlehem forged pressure vessel is of two-layer, shrink-fit construction. The two shells and all the head closure parts were forged from alloy steel. The vessel measures 122 inches in length and weighs a little over 30 tons. Diameter inside is 18 inches; outside it's 49½ inches.

Like all Bethlehem forged vessels—whether they tip the scale at 150 tons or 900 pounds—this one is built for long, heavy-duty service. Our technical men will be glad to work closely with you. Once the design is approved, you can count on our shops to follow through with a first-rate production job.

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Eliminate accounting losses in custody transfer of gases...with the NEW HONEYWELL GAS FLOW COMPUTER

When you're selling or buying gas, even a slight inaccuracy in flow measurement can mean the loss of many dollars. Prevent this loss with the accurate, all-electric gas flow computer. It measures, records, and totalizes *mass rate* of gas flow, automatically and continuously. Temperature and pressure variations are compensated for automatically—eliminating the inaccuracies of "averaging" and other methods of computation.

The gas flow computer does away with tedious, time-consuming calculations and the possibility of human error. In most applications, it will perform with accuracy of ±1%, and, under ideal conditions, with accuracy of ±½%. You can use this new computer to measure mass flow of such gases as ammonia, hydrogen, ethylene and other hydrocarbon gases, as well as hydrochloric acid gas. And you can easily link it to telemetering and remote control systems, supervisory control, data handling, and industrial process computers. Cost of the computer in most installations runs less than $4000.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

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Here's how the Honeywell gas flow computer solves a gas flow equation:

$$Q = K\sqrt{\frac{hP}{TGZ}}$$

Where **Q** = mass rate of flow, scfh
h = differential pressure, inches of water
P = static pressure, psia
T = flowing temperature, °R, (°F + 460)
G = specific gravity
Z = super-compressibility
K = orifice flow constant

The *ElectriK Tel-O-Set* △P/I transmitter measures *h*; an absolute pressure transducer measures *P*; and a resistance thermometer bulb measures *T*. The analog computer multiplies *h* by *P* and divides by *T* . . . and sends a resultant millivoltage to the *ElectroniK* recorder. The recorder applies the correction factors *G* and *Z*, extracts the square root, and records the resultant mass flow Q.

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Honeywell
First in Control
SINCE 1885



Versatile low-cost

FEDERATED ZINC DUST

Now being used as a reducing agent, precipitating agent, purifier, catalyst, polymerizing agent, and in rust-resistant paints, bleaches, pyrotechnics, soot-removal, pipe thread compounds, and Sherardizing, zinc dust often does a better job than other compounds at less cost. Federated Zinc Dust is 97% metallic zinc, with a 97% through 325 mesh screen fineness. Send for half-pint experimental lot, and call on Federated's research and engineering assistance. Write or call: Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y. or your nearby Federated sales office.

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The customer who thought he got something special

A Gulf Coast oil refiner was in a hurry to build a new catalytic platformer. He needed a special analysis of seamless steel tubing—delivered from the mill in just the exact size and length. But, the refiner was afraid he wouldn't get the steel on time.

A team of Timken Company experts tackled the problem. They got the steel out on time—so fast that the refiner thought he received special treatment.

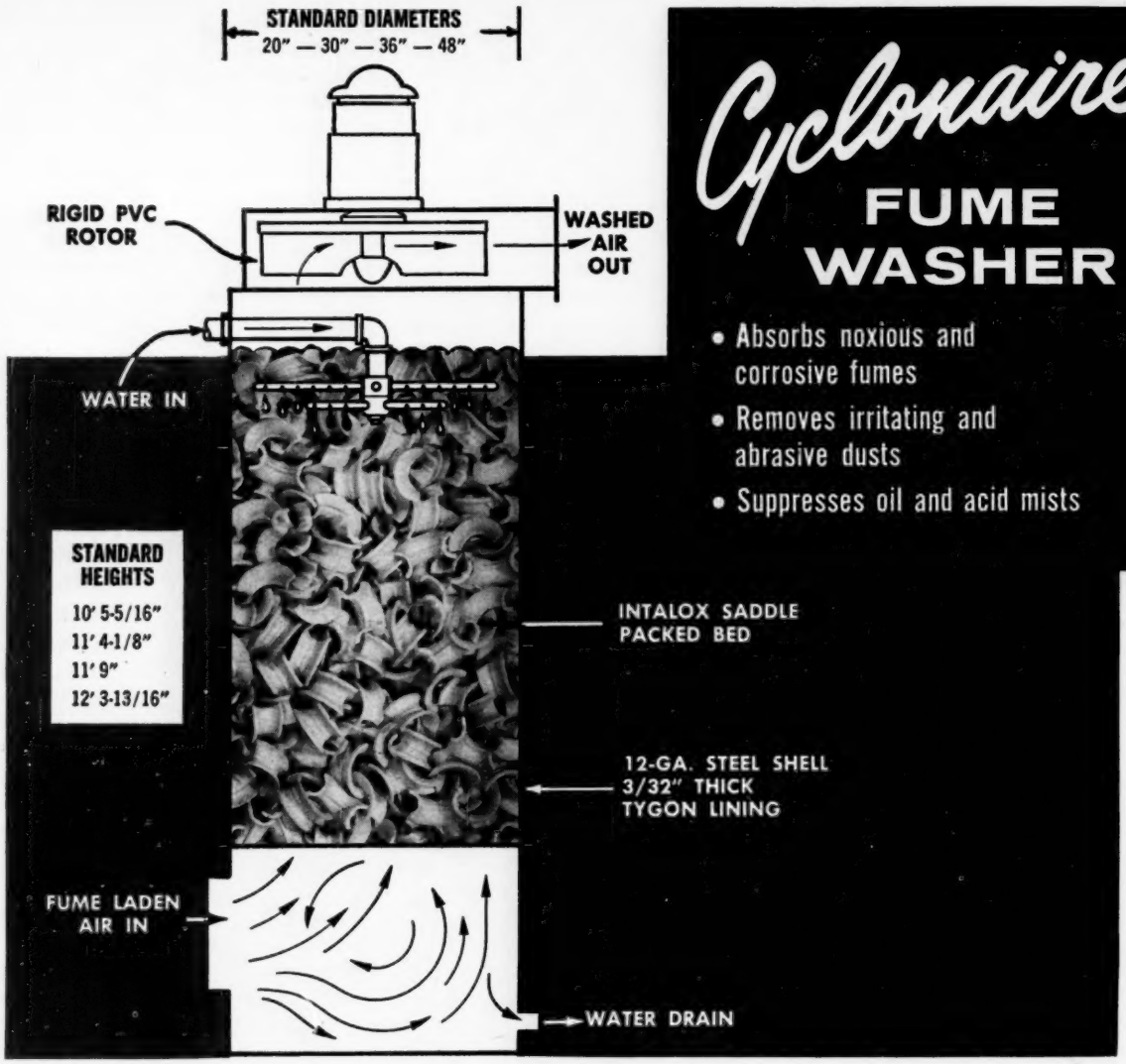
And he did—the very same special, individual treatment we're geared to give *every* customer—and do!

This order was routine for our team of metallurgical-production-operating people. Special jobs are right down their alley because they have the know-how and the facilities. You can call ours a tailored operation—but it's really more. The steel was babied all the way. Every modern quality control device kept an eye on the steel all through the melting, rolling, piercing, finishing. It passed every inspection for surface, size and quality and there wasn't a minute's delay. That's the kind of special treatment that's made the Timken Company a leading producer of special quality fine alloy steel.

If you want your steel to receive special treatment, give your next order to the Timken Company, where *every* order is special. And for help in solving your steel problem, consult our metallurgists. They've probably solved a problem similar to yours dozens of times.

The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO". ***Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.***





Cyclonaire FUME WASHER

- Absorbs noxious and corrosive fumes
- Removes irritating and abrasive dusts
- Suppresses oil and acid mists

The "Cyclonaire" is a surprisingly compact wet bed scrubber. It will fit almost anywhere, but it does a fume removal job formerly possible only with expensive custom-designed units. Removal of many gases (of 1% concentration or less) is up to 99% effective. Low power requirements make it very economical to operate.

The standard "Cyclonaire" consists of a bottom section containing a packing support plate, fume intake duct, and liquid drain; two intermediate sections packed with Intalox Saddle Packing; a distributor section containing a water or liquid inlet and liquid distributor; and a top section containing the blower, drive motor and washed air outlet.

The unit is made of 12 gauge steel, lined with 3/32" thick Tygon sheet plastic. The rotor is made of rigid PVC plastic. All exterior surfaces are protected with Tygon "ATD" Hot Spray Paint.

The "Cyclonaire" is available in four sizes with rated capacities of 750, 1650, 3500 and 6000 cfm.

Its low initial cost, its low operating cost, its high efficiency make the "Cyclonaire" a logical choice for a wide range of fume scrubbing operations. Full technical data in Bulletin FW-10. Write for it today.

PROCESS EQUIPMENT DIVISION

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DEVELOPMENTS . . .

JUNE 27, 1960

Chementator

T. PETER FORBATH

Houston Chemical plans to make tetramethyl and tetraethyl lead in competition with DuPont and Ethyl. Firm, formed by Philadelphia & Reading and Chatham Chemical, has acquired site adjacent to Mobil Oil's Beaumont, Tex., refinery, also intends to get into ethylene-oxide-and-derivatives business..

New process for gasifying low-grade coal will be studied in $630,000 pilot plant by England's Gas Council. Plant is to produce 2 million cu. ft./day water gas by "forcing powdered coal with air, oxygen or steam into a bed of molten slag."

Food Machinery and National Distillers have won $20-million contract to supply Air Force with unsymmetrical dimethyl hydrazine. Rocket-fuel component, called Dimazine, is most likely slated for propellant system of Titan missile (Chementator, May 30, p. 38).

New maleic process taps cheap feed

Petro-Tex Chemical's new maleic anhydride process (*Chementator*, June 13, p. 69) has a good many engineers wondering just what effect it will have on the already muddled maleic marketplace (*Chem. Eng.*, Dec. 14, 1959, p. 78). For the company's 30-million-lb./yr. plant, to be on stream in mid-1961 near Houston, will charge as feedstock a low-cost C_4 stream instead of the usual, more-expensive benzene.

Advantage of this route is obvious. Using a four-carbon feed (not butylene, stresses a Petro-Tex spokesman) to make a four-carbon product raises theoretical yield 33% over the benzene-fed processes. But while this has been obvious for many years, no one has been able to get maleic yields anywhere near theoretical until now.

Best present conversion of benzene is slightly over 80%. Petro-Tex indicates it will get around 90% conversion in commercial operation, thus expects about a 40% edge in maleic yields over any benzene flowsheet. One reservation observers are inclined to point out, however, is that economic advantage of the process may be confined to areas where C_4's are in plentiful supply (e.g., the Gulf Coast).

Petro-Tex is currently seeking patents on its process, thus is not giving out any details other than to say that it's a fixed-bed catalytic oxidation. Company will not consider licensing process until patent situation is clearly established.

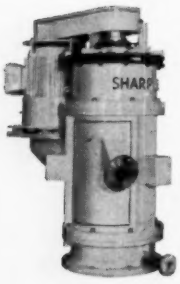
Mystery polymer resists brutal heat

Discovery of a new, carefully unidentified family of polymers that are stable to a searing 1,110 F. was reported last month by Artrite Resins Ltd. (Camberley, Surrey, England). Moreover, company claims that the polymers exhibit molding characteristics similar to those of phenolic resins plus high thermal strength and thermal shock resistance.

Discovery, Artrite believes, opens a new

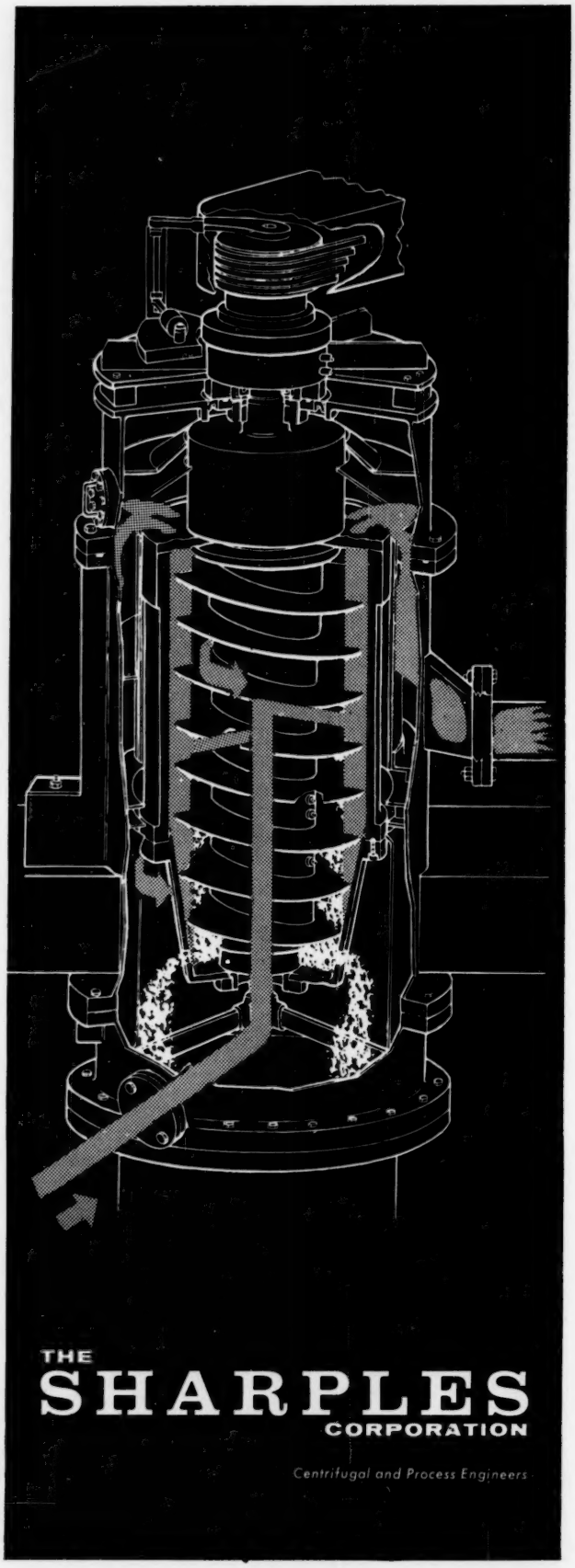
The P-4000 Super-D-Canter designed exclusively for Centrifugal Separation Under Pressure

- Simple mechanical sealing maintains pressure effectively.
- Gear box, seal, etc., are protected from contamination by process fluid.
- "Plumb bob" suspension minimizes foundation cost.
- External connections for feed, solids discharge, and liquid discharge are conventional flange connections.
- "Drop-through" solids discharge offers advantages in many applications.
- Built-in solids rinsing feature available.
- Performance characteristics:
  Capacity—liquids, 75+ gpm
  solids, 3+ tons/hour
  Operating Speed—4,000 rpm
  Centrifugal force—3,200 × G
  Pressure—to 15 psi (can be operated at atmospheric pressure)
  Particle Size—from a few microns up to ¼" or more depending on requirements.
  Solids concentration in feed—approx. ½ to 50%.
- The P-4000 Vertical Super-D-Canter offers many operating advantages not previously available. Write today for the new technical bulletin on this advanced design centrifuge by Sharples.



The vertical design of the Super-D-Canter makes it essentially "a bulge in a pressurized System".

●*Write for Bulletin 1287*



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Centrifugal and Process Engineers

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field of polymer chemistry with "possibilities equal to the introduction of silicones." Materials are described as "more like ceramics than plastics but use the same preparative processes as normal plastics and their toughness is greater than ceramics." Applications are expected in missiles, high-speed aircraft.

Artrite's mysterious polymers meet specifications that go considerably beyond the immediate goals and achievements of current U.S. efforts to combine properties of heat-fighting but brittle ceramics with easy-to-fabricate but heat-shy plastics. U.S. experts tell *CE* that the organic-containing solid polymers known here, at best, withstand 500 F. And inorganic polymers at present can only cope with temperatures up to 900 F.

Artrite isn't releasing details because materials were developed under defense contracts. But British trade sources indicate that polymers contain phosphorus and boron. And a mysterious compound, polyphenylene boronous acid, has been mentioned as having some connection with the new materials.

U. S. researchers can't conceive that polymers stable above 1,000 F. would contain significant amounts of organic materials in their molecular structure. As for inorganic phosphorus-boron polymers, phosphinoborines have been developed (e.g., a 6-membered cyclic compound at Wright Air Development and a linear compound at American Potash & Chemical) that will stand 660-850 F. But even in inorganics, anything over 500 F. is still considered quite an achievement.

In Russia and England much research has been invested in modifying the inorganic network of natural polymers such as silica. Forming their polymeric links, oxygen usually alternates with one other element (e.g., silicon). By replacing half of the latter with a third element (e.g., boron) and breaking the symmetry of the natural molecule, researchers hope to alter undesirable properties like brittleness while maintaining heat resistance. Work along these lines also has been done by such U. S. firms as U.S. Borax. And though products withstanding about 1,830 F. have been claimed overseas, results in this country indicate that the best possible is 930 F.

Commercialization of tar sands nears

What could be the first commercial installation for exploiting Canada's vast and long-eyed tar sands deposits may now be just a procedural step away from heading down the road to reality.

Great Canadian Oil Sands Ltd. (New York) has filed an application with the Alberta Oil and Conservation Board for approval on a $100-million project to produce 31,500 bbl./day of synthetic crude oil from the McMurray tar sands of the Mildred-Ruth Lakes area some 300 miles north of Edmonton, Alta. Should GCOS get the Board's okay, it would begin construction on the facility later this year, shoot for initial plant startup by the fall of 1962 and full production the following spring.

Company already has made arrangements for sale of most of the output. Sun Oil has contracted for 15,000 bbl./day, Canadian Oil for 5,000 bbl./day for processing into various petroleum and petrochemical products.

Project is based on over 15 years of research and development by the Research Council of Alberta and GCOS. It's described as technically feasible and, at the planned production rate, economically sound as well. According to GCOS, tar-sands-base crude oil could be marketed at the same price as petroleum-base crude.

A hot-water-wash process, which has been demonstrated in a 500-ton/day pilot plant, would serve to extract bitumen from mined sand. Bitumen then would be deaerated, dried and fed to a coking operation where naphtha and gas oil would be produced. Both streams would be desulfurized, then blended into saleable synthetic crude oil. GCOS's plans call for a 290-mile, 16-in. pipeline to transport product to Edmonton where Sun and Canadian Oil would take title to it. At present, GCOS has no plans for marketing byproducts such as fuel gas, fuel oil, coke and sulfur.

Freeze-desalter boasts big crystals

News of another major freezing process is the latest development in the government-sponsored program for economically making fresh water from salt water.

Key virtue of this process, a joint development of Struthers Wells (Warren, Pa.) and Scientific Design (New York), is that it produces much larger ice crystals from saline-water feed than competing freezing routes. Thus it may make separation of fresh-water ice from unfrozen brine a much simpler, cheaper job.

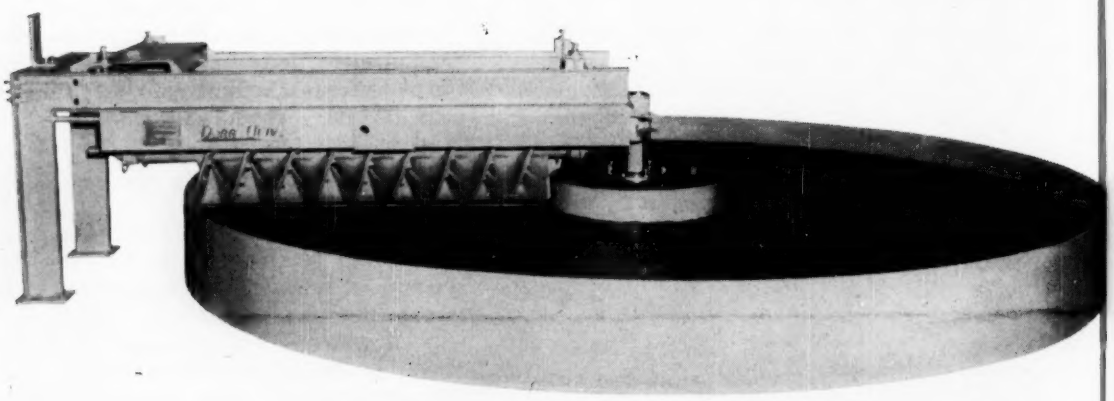
(Continued on page 58)

Oliver Horizontal Rotary Filter a
Cia. Productora Nacional de Aceites, S.A. pl
—an outstanding example of the succ
of the solvent extraction proc
for vegetable oil producti



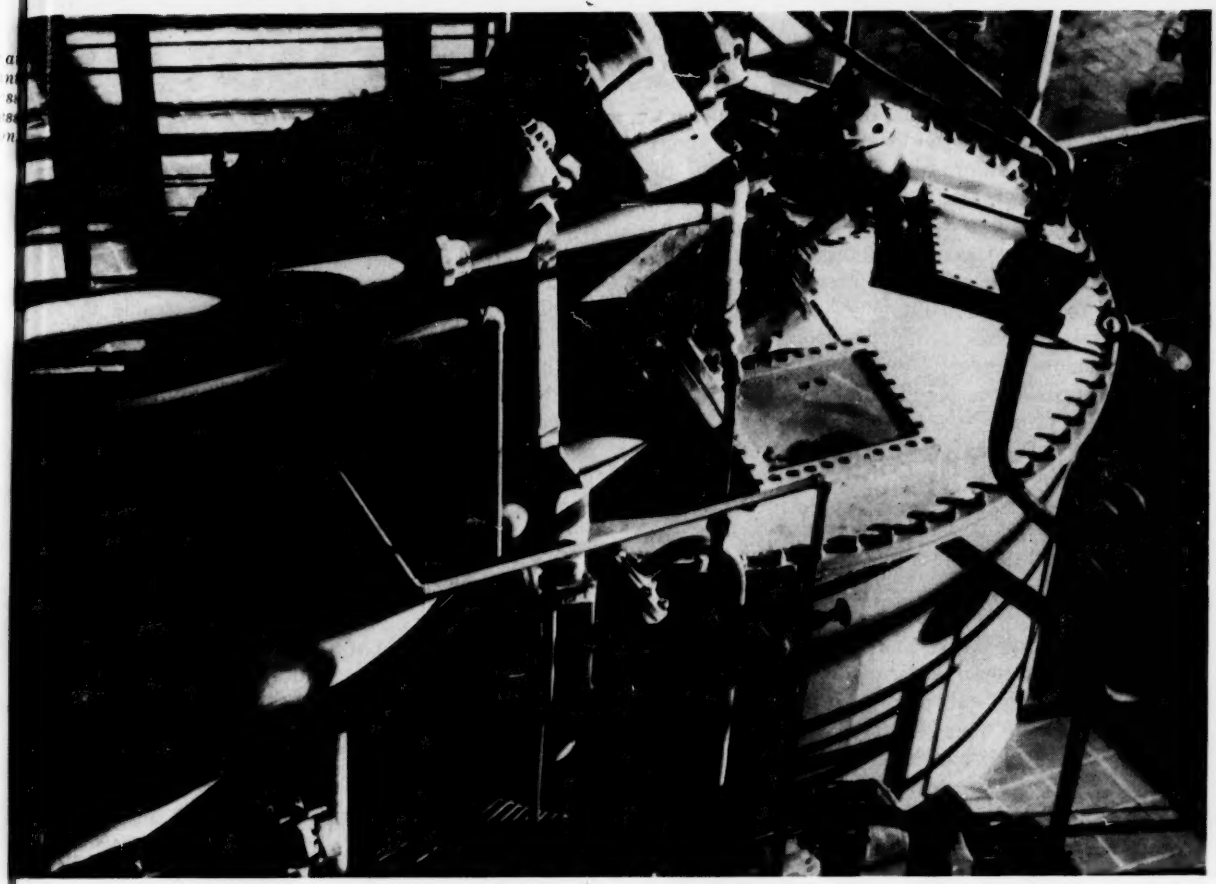
Unique
vegetable oil
extraction process
depends on . . .

OLIVER HORIZONTAL



Oliver Horizontal Filter without cover. Scroll shown is for cake discharge, although paddle wheel or bar flite can be employed.

Filtrex—T. M. Wurster & Sanger, Inc.
Oliver—Reg. T. M. Dorr-Oliver Incorporated



ROTARY FILTER

Up to 99% extraction from sunflower seed meats and rice bran without pressing achieved at plant of Cia. Productora Nacional de Aceites, S.A., Santiago, Chile

The "Filtrex" direct solvent extraction process, commercialized by Wurster & Sanger, Inc., Chicago, Ill., is demonstrating its efficiency in a plant established by Cia. Productora Nacional de Aceites, S.A., Santiago, Chile. Materials handled are sunflower seed meats and rice bran. Extracted oils are refined and used for liquid cooking and salad oil, shortening and margarine.

The major equipment item and key to the simple, economical operation of the Filtrex process is the Oliver Horizontal Rotary Filter. This unit separates the full miscella (vegetable oil-hexane mixture) from the meal solids and counter-currently washes the solids to remove entrained miscella. Arrangements provide for 5 liquid cuts: separation of full miscella from solids, followed by three cuts from progressively lower oil content miscellas, the last wash being oil-free hexane. Extraction efficiency ranges up to 99%. Final oil clarity is such that further filtration is not required.

This application is another example of the adaptability of the Oliver Horizontal Rotary Filter to a wide range of filtration and counter-current washing operations, particularly those involving fibrous and granular materials. For full information, write to Dorr-Oliver Incorporated, Stamford, Connecticut.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

Both Carrier and Blaw-Knox, current leaders in the freeze-desalination field, have processes in which feed is quickly frozen to form small crystals that subsequently must be freed of brine in a complex washing operation. The SW-SD process uses the evaporation of a hydrocarbon in direct contact with saline water to get slow, controlled growth of large ice crystals. Exactly how it accomplishes this, its developers aren't willing to divulge. All SW and SD say at this time is that process requires "proper nucleation, proper crystal growth patterns and a specially designed crystallizer."

SW and SD developed their process in a 30-gal./day laboratory unit. Now, at the request of the Dept. of Interior, they are preparing a proposal for a 10,000-gal./day pilot plant to be built partly with Federal funds.

Main aim of SW and SD is to have their process considered for use in the forthcoming 100,000-250,000-gal./day freeze-desalination demonstration plant that the Interior Dept. plans to build somewhere on the East Coast. But they face a rugged time schedule because the Interior Dept. expects to select a flowsheet for that plant early next year based on data from pilot plants operating in the 10,000-gal./day class. Carrier already has such a unit on stream; Blaw-Knox expects to start one up early this fall.

Coal mines to be new aluminum source?

North American Coal's announcement last month that it will build a 40,000-ton/yr. aluminum sulfate plant may have a significance reaching considerably beyond the original statement. For if the company's total plan materializes, the North American continent will have a new source of aluminum, won from a heretofore waste material of coal mining.

NAC's Ohio mines produce millions of tons per year of shale along with coal. This shale, removed in a washing plant, contains 20-25% alumina which has always been discarded. New alum plant, to be erected near Powhatan, Ohio, is only the first step in what the company hopes will eventually be an integrated aluminum complex based on the shale waste.

Process to be used is the invention of the late Dr. Marvin Udy and has been piloted by the Udy-fathered Strategic Materials Corp. in a one-ton/day facility at Niagara Falls, N. Y.

Alumina-bearing shale is leached with sulfuric acid, solubilizing the aluminum content. Silica and other impurities are filtered out and then aluminum sulfate is recovered by fractional crystallization. Recrystallizing gives alum with less than 0.005% iron, more than meeting commercial iron-free alum specifications. NAC feels its process will be cheaper than conventional routes—which must start with pure alumina—for making this grade.

But biggest money-making potential lies in the next step. Alum can be thermally decomposed to alumina while acid values are recycled to leaching section. Low-soda content of this alumina makes it suitable for electrolytic reduction to aluminum metal or for use in ceramics. Complete economics for this stage have yet to be worked out.

Price of stainless exchanger tubes cut

Price of welded stainless tubing is coming in for some marked reductions, *CE* learns. During the past few weeks, Carpenter Steel's Alloy Tube Div. (Union, N. J.) has started quietly circulating a new published price schedule that offers, in many instances, savings upwards of 20% to stainless-tube buyers, most notably to heat-exchanger manufacturers.

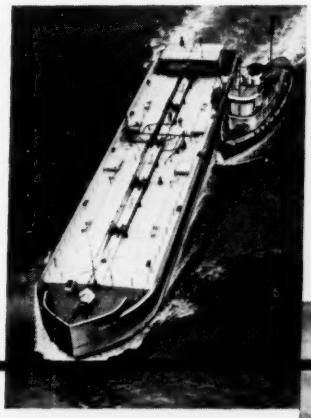
Carpenter's action represents the first official recognition of a pricing situation in stainless tubing that has been evolving steadily over the past year. Heat-exchanger manufacturers tell *CE* that they've been able to get "pretty much Carpenter's new prices" from other firms even though those firms have persisted in quoting much higher figures in their official price lists. Confirming this situation, one tubing fabricator states flatly, "We can, do and will meet Carpenter's new prices."

Behind this pricing situation stands the growing importance of small-volume buyers, chiefly the small shops scattered about the country that are taking over an increasing share of the heat exchanger business. Tube fabricators, keen on winning this market, have taken to adjusting their prices primarily so as to allow small-volume customers to qualify for "quantity bargain rates" on much smaller orders than previously possible.

In Carpenter's new price schedule, base price per foot is now quoted on orders as small as 10,000 ft. of tubing instead of the traditional 40,000 or 50,000 ft. In addition, company has cut price per foot itself some 10-20% depending on the size order.

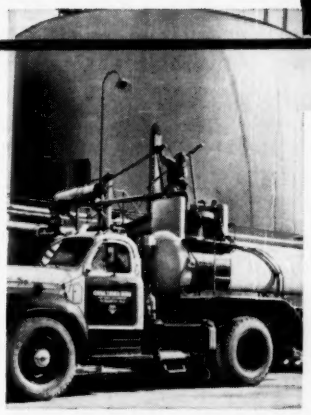
One exchanger manufacturer illustrates the sort of savings the new price schedule

To recover spent sulfuric, call on the leader in sulfuric





GENERAL CHEMICAL



Of General Chemical's 21 sulfuric plants, 15 are equipped to handle spent sulfuric! Here are their locations:

Anacortes, Washington
Barnet, British Columbia*
Baton Rouge, Louisiana
Buffalo, New York
Denver, Colorado
East St. Louis, Illinois
Elizabeth, New Jersey
El Segundo (Los Angeles), California
Hegewisch (Chicago), Illinois
Newell, Pennsylvania
North Claymont, Delaware
Port Chicago (San Francisco), California
Richmond (San Francisco), California
River Rouge, Michigan
Valleyfield, Quebec*

*In Canada: Allied Chemical Canada, Ltd.

If you are seeking to recover spent sulfuric acid from your operations and your plant is in the vicinity of any of those listed above, it may pay you to talk to General Chemical.

As the nation's leading sulfuric producer, General has years of experience in recovering many types and strengths of spent acid for its customers. While all cannot be reclaimed, we will be happy to review the economics of recovering yours. As always, the assistance of our technical service staff is readily available to help solve any spent acid handling and disposal problems you may have.

Basic to America's Progress

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

makes possible on Type 304 stainless, ¾-in.-O.D., 18-gage, 10-30-ft.-long welded tubing. Orders of 40,000 ft. are now priced at about 60¢/ft. while previously it was about 68¢/ft. Orders of 10,000 ft. now also run around 60¢/ft. while previously price was about 75¢/ft. Orders of 2,500 ft. now cost roughly 66¢/ft. whereas before price was about 80¢/ft.

Chemical revisions up open-hearth rate

Use of burned lime instead of limestone for flux along with oxygen-natural-gas combination lances can significantly boost production rates of open-hearth steel furnaces.

So declares Ford Motor Co. (Detroit), which last month unveiled results of experiments it has been conducting with these steelmaking innovations as part of a $35-million modernization and quality improvement program. Applied to a 200-ton furnace, a company spokesman reports, these techniques succeed in upping output from 20 tons/hr. to over 60 tons/hr. Experiments on a 400-ton unit indicate that output can be raised from 30 tons/hr. to about 100 tons/hr.

Combination oxygen-fuel lances provide considerably higher temperatures than the usual "end-firing" fuel burners supported by oxygen lances. Thus, time needed to heat initial open-hearth charge (scrap steel and flux) to the "satisfactory state of liquidity" required before molten iron can be charged is markedly sliced. And use of burned lime instead of limestone "makes still more heat available," thus permits molten iron to be introduced much sooner than ordinarily possible without running risk of "freezing" furnace charge.

Tomorrow's Technology

Today's embryonic developments which have special significance for chemical engineers

Zirconium salt as atom moderator

Can zirconium hydride serve as the stable, thermally unshielded moderator that engineers have been seeking to replace water in the superheater portion of boiling-water nuclear reactors?

That's what North American Aviation's Atomics International Div. (Canoga Park, Calif.) intends to find out in its just-launched research program for the Atomic Energy Commission. Company will conduct preliminary studies on 300,000-kw. and 50,000-kw. "paper" reactors using slightly enriched uranium.

Spur for the studies are two key characteristics of zirconium hydride. While a water moderator needs thermal-neutron shielding by stainless, ZrH requires no such shielding. Significance of this, besides the savings in shielding possible, is that reactor performance no longer would be impaired by the high-neutron-absorption character of stainless. Thus, a ZrH-moderated reactor could be fueled with low-cost slightly enriched uranium. Moreover, ZrH is considerably more stable than water in a radiation environment. This means reduced corrosion and improved reactor performance.

On the debit side, of course, is the fact that ZrH costs substantially more than water. ZrH runs about $30-$50/lb.; some 35,000 lb. would be required in a 300,000-kw. reactor. But AI believes that potential reduction in fuel costs possible with ZrH moderator may offset this increased initial expense.

Research and development briefs

Acoustic vibrations boost heat transfer rate, reports Southwest Research Institute (San Antonio, Tex.). SwRI researchers find that water-side heat-transfer coefficients can be increased 10% (N_{Re} 20,000) up to 450% (N_{Re} 540) by applying 42 cps. vibration on a 1-in.-O.D. pipe installed inside a 3-in.-O.D. pipe through the annular space of which water is pumped.

New fuel cell, based on reaction between hydrazine and hydrogen peroxide, is under development by Chloride Electrical Storage Co. (Manchester, England). Advantages claimed for device include low operating temperature, high power-to-weight and power-to-volume ratios. Major drawback: High cost of hydrazine compared with usual fuel-cell-fuels.

Conical, segmented solid propellant offers means of economically fabricating very large (over 1-million-lb. thrust), reliable solid rocket motors, United Technology Corp. (Sunnyvale, Calif.) maintains. National Aeronautic and Space Agency has awarded UTC contract to build and test three engines of this design.

For more on DEVELOPMENTS.....62



Quality control is a relentless task at J&L. Here a skilled metallographer examines steel structure through a modern photomicroscope.

Be 100% Certain...Buy 100% Tested Pressure Tubing

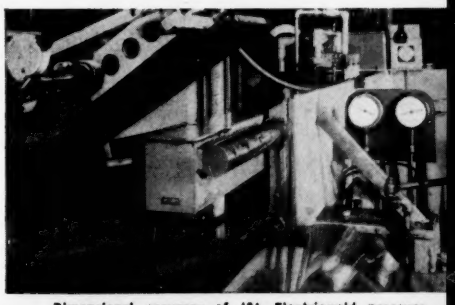
J&L Electricweld pressure tubing is the finest carbon steel tubing available for heat exchanger, condenser, boiler, evaporator and other applications—yet shows savings of as much as 45% against seamless tubing.

J&L Electricweld pressure tubing provides the uniform outside diameter, wall thickness and concentricity that guarantee excellent heat transfer characteristics and fine surface quality. Its strength and ductility assure easy fabrication and installation.

J&L Electricweld pressure tubing is subjected to precise checks at every stage of production, from the basic steelmaking process until the tube is ready for shipment. This series of critical examinations on every length of tubing—inside and out—assure you of perfect field performance. Further details of Electricweld tubing and the economies it offers compared with seamless are available on request from J&L—creator and producer of *unmatched* Electricweld tubing.



J&L uses this latest type of electro-magnetic non-destructive tester to inspect both the inside and outside of Electricweld pressure tubing.



Dimensional accuracy of J&L Electricweld pressure tubing is determined long before fabrication. Shown here is an X-ray gauge control device which continuously measures the gauge of the sheet and strip steel.

This Steelmark identifies products made of steel. Place this mark on your products. And—look for it when you buy.

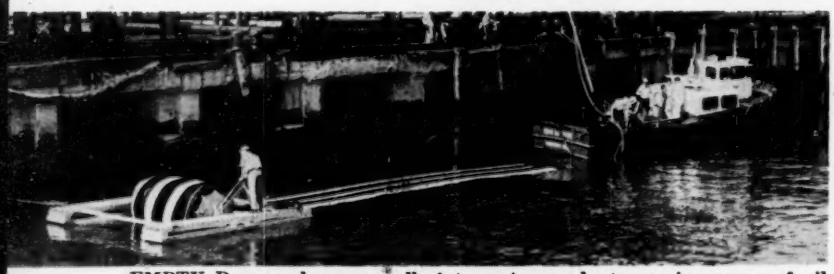
Steel

J&L STEEL

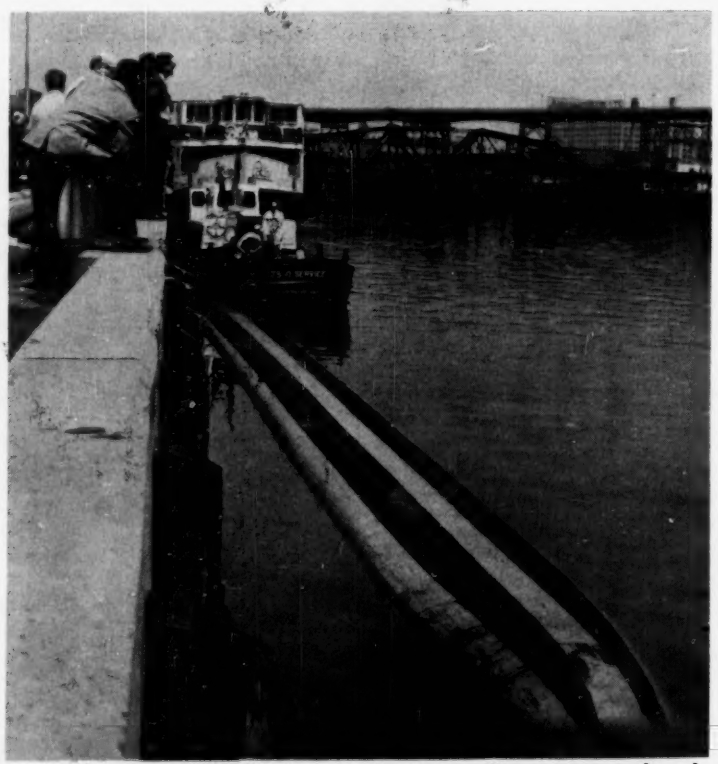
Jones & Laughlin Steel Corporation

ELECTRICWELD TUBE DIVISION • 3 GATEWAY CENTER, PITTSBURGH 30, PA.

Nylon-Rubber Barge Makes U. S. Debut



EMPTY Dracone barge unrolls into water ready to receive cargo of oil.



LOADED Dracone is readied for unloading by coupling to pump on launch.

BALLASTED with CO_2, empty Dracone rides high in water on return trip.



Fresh from success on tows abroad, the Dracone shows impressive capability in its first U. S. trial at New York.

Seeing was almost disbelieving recently for two New York City helicopter policemen who spotted a Dracone flexible barge under tow for the first time in New York Harbor. But among transportation men on an accompanying observation vessel there was considerable believability about potential usage of the Dracone, based on what they saw.

Looking like a mammoth striped tree trunk awash in the briny, the Dracone was carrying 10,000 gal. of heating oil in a special demonstration run, its first U. S. appearance. Staged by Dracone Operations, Ltd. (London), and Marine Brokerage, Inc. (New York), with the cooperation of Esso Standard, this demonstration enabled U. S. observers to see why the Dracone has won some commercial acceptance abroad.

▶ **Catches On Abroad**—Esso Petroleum Co., Ltd., has used Dracones successfully for about 18 mo. hauling gas oil, diesel oil and kerosene from the refinery at Fawley, England, to the Isle of Wight. Others are in use on Southeast Asian locations; one is scheduled to go to Japan within the near future. Evaluations have been carried out by Imperial Chemical Industries and the English army.

Dracone's New York appearance may well presage future usage on U. S. waterways. But any positive moves in this direction must await approval by the U. S. Coast Guard, based on report filed by officers present at the New York demonstration.

Should such approval be forthcoming, potential users will find Dracone Operations, Ltd., now offering price reductions up to 30% on bulk orders of six or more units. Single unit prices range from $14,110 for 35 tonner to $55,455 for a 320 tonner, including all ancillary equipment.

▶**Built Like Sausage**—For its New York demonstration, Dracone Operations, Ltd., used a Type D Dracone measuring 100 ft. long with 4.75 ft. dia. and holding 35 tons or 10,000 Imp. gal. of 0.8-sp.-gr. liquid. The 2,500-lb. bag is only 0.15-in. thick, constructed of nylon lined internally with Hycar and externally with Neoprene.

Ends are tapered, terminating in a towing eye forward and a mooring lug and tail pipe aft. There are no internal baffles. But around the outside of the tail is a circular stabilizer collar which interrupts laminar flow along the skin to prevent switching of the tail.

Ratio of length to diameter is fixed at 20:1 to minimize internal pressures at approximately 0.5 psi. With use, bag stretches from initial capacity of 9,500 gal. to 10,500 gal.

▶**Mounts On Reel**—Dracone Operations, Ltd., started its demonstration by unrolling the deflated Dracone from a pontoon-mounted reel into the water adjacent to a pier at Esso Standard's Constable Hook refinery, Bayonne, N. J.

Through a 4-in. hose connected to the Dracone tail pipe, Esso loaded 10,373 gal. of heating oil in approximately 15 min. During final 20% of loading, bag dropped from flat elliptical shape to more circular cross section producing maximum draft at about seven eighths submersion.

After loading, tail pipe was blanked off with flange attached to a float. Second float with 6-ft. staff to hold flag and light was made fast astern to mark the tow.

▶**Emulates Serpent** — Loaded Dracone was towed 11.2 mi. to Esso bulk terminal on Newtown Creek, Brooklyn, for delivery of the oil. As the Dracone moved along, its flexible nature allowed it to undulate over the waves. And when the towboat turned sharply, the Dracone bent in the middle to make a tight turn behind the boat.

The 35-ft., 250-hp. towing launch could have towed as many as four Dracones side by side without trouble, according to Dracone representative. At 7-knot towing speed, the tow exerts 1,200-lb. pull on the tow line.

▶**Unload and Return**—At Newtown, unloading took about 50 min. using a helical positive displacement pump. To facilitate this operation, weights totaling 120 lb. were hung on the nose to drag it down as bag emptied, thereby collapsing the bag to assure that all oil moved to the discharge pipe at opposite end.

For return trip, bag was ballasted by inflating with 200 lb. of CO_2. If reel had accompanied tow, Dracone would have been wound on reel for return. In some cases, air ballast charged with fan at 10 in. w. p. is acceptable.

▶**Withstand Abuse**—Life of Dracones is estimated to be at least five years under rough working conditions. Unlike steel, the nylon-rubber skin needs very little maintenance. In case of damage, patching is relatively easy.

Ability to exhibit such toughness is expected to extend Dracones into the haulage of a broad range of petroleum products as well as edible oils, solvents and other liquid chemicals with specific gravity less than one. And they may even win recognition for handling free-flowing solids such as grains.

Most likely entree for Dracone to U. S. waterways (if approved by USCG) will be where docking facilities are poor, channels shoal or bridges low. But successful open-sea trials may point to uses in that direction, also.

Helium Liquefaction to Be Put on Large Scale

A new mobile helium liquefier promises to put production of liquid helium on an impressively large scale.

Designed and built by Air Products, Inc. (Allentown, Pa.) for the Bureau of Naval Weapons, liquefier turns out the equivalent of 45,000 cu. ft./day liquid from high-purity helium gas. That output, claims Air Products, makes the unit the largest helium liquefaction plant in the world. But, more importantly, liquefier is described as "the forerunner and prototype of an even larger unit to be built in the future." Bureau of Mines is considering a 300,000-cu. ft./day liquid helium facility.

Spur behind the work to put liquid helium production on a much larger volume basis than presently is the savings possible when this increasingly widely used material is shipped as a liquid instead of as a gas. For example, a liquid helium railroad tank car can carry about ten times as much product as the present compressed-gas tank cars. And a highway tank trailer loaded with liquid will haul roughly 15 times as much helium as its gaseous counterpart.

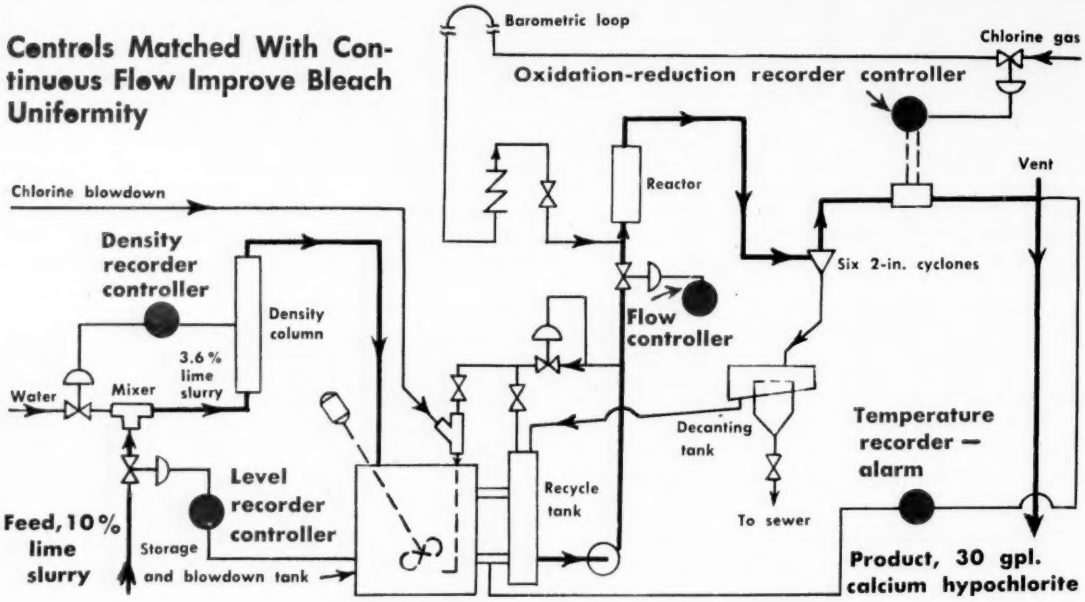
Time Off to Be Granted For Political Activity

"Employee participation in political party activity is important personal business of the highest order."

Thus declares L. F. McCollum, president of Continental Oil Co. (Houston, Tex.). And as this election year begins to work up a full head of political steam, Conoco has backed this view with a formal policy to grant its employees time off from work without loss of pay to participate in political party activities. This may be the first time an American industrial concern has announced an official, written policy of this type, a Conoco spokesman ventures.

Conoco's policy applies to employees who have been elected and are serving as officers at the precinct level and above in the Democratic and Republican parties. It also applies to those employees who have been elected and desire to serve as delegates to any regular political convention of either party. Time off, not exceeding three days, will be granted to Conoco personnel to attend a convention to which he's an elected delegate. And time off will also be given to personnel, who are elected party officers, for election-day activities.

Controls Matched With Continuous Flow Improve Bleach Uniformity



Bleach-Process Record Confirms Hopes

What properly controlled, continuous reacting can do for production of bleach liquor is disclosed by bleached-kraft-pulp maker.

By producing calcium hypochlorite in a continuous controlled system, British Columbia Forest Products, Ltd., is getting better control of bleached-pulp quality at its Crofton, B. C., kraft mill. Yet, at the same time, operating and chemical costs are down to a minimum.

So report BCFP engineers who collaborated with engineers from H. A. Simons, Ltd. (Vancouver) and Hooker Chemical Corp. on design details at Crofton, based on a system developed by Hooker's Western Chemical Div. (U. S. 2,889,119; Canadian 571,741). And the design they produced saved considerable space and capital investment.

In continuous operation since January 1958, the BCFP hypochlorite bleach liquor plant can maintain production of liquor at any rate from 40,000 to 200,000 gal./day and with any concentration of available chlorine from 15 to 50 gpl. Excess alkali can be held as low as 0.2 gpl.

▶ **Start With Lime**—Production of bleach liquor starts with slaking of reburned lime to a slurry concentration of 10% solids. Discharging from the slaker, slurry flows through a 6-in. cyclone for removal of +50 micron particles. Oversize recycles to slaker; slurry passes through shell-and-plate cooler for cooling to 90 F. before entering 10,000-gal. storage tank.

Transfer of slurry from storage to 8,000-gal. downstream feed tank is governed by level controller in feed tank. During transfer, slurry passes through mixing tee for dilution to 3.6% solids content, controlled by density detector which actuates dilution water valve.

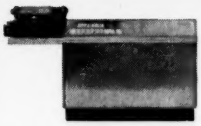
▶ **Improved Reactor**—To supply feed to the hypochlorite reactor, a pump withdraws the dilute 70-F. slurry at a normal controlled rate of 80 gpm. An additional 50-100 gpm. circulates through the recycle tank (explanation later).

Entering a tee, the lime slurry mixes with chlorine gas at constant pressure and immediately passes into compact forced circulation reactor at 35 psi.

Featuring the latest design, this reactor offers many advantages over previous coil and draft-tube hypochlorite units, it is said. These include pressurized reaction, multiple passes, short retention time, minimum scaling, capacity ranging from 30 to 140 gpm. and compact 5-ft. height which permits easy installation and maintenance.

▶ **Short Duration**—Within 15 sec. after entering reactor, liquid stream contains 30 gpl. of hypochlorite and the temperature level has risen to 88 F. Then product discharges through a bank of six 2-in. porcelain cyclones which take out all +20-micron particles.

Cyclone overflow looks somewhat milky from 0.2% inert suspended solids. Even though harmless, these solids are re-



LGP-30 COMPUTER ABSTRACTS

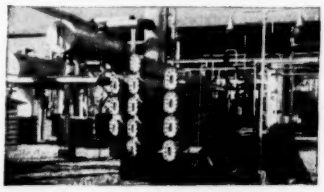
(Application Report #10, from which the following is abstracted, is free upon request from Royal McBee Corporation, Data Processing Division, Port Chester, N. Y.)

Subject: Design / User: Brown Fintube Company, Elyria, Ohio

THE PROBLEM: rush quotation for heat exchanger to potential customer. Determine best heat exchanger vs. cost combination. Perform necessary computations to obtain values for total surface area; total number of exchangers; area/exchanger; velocity and pressure drop – shell and tube; film coefficient; log mean temperature difference; overall transfer rate; clean rate; overall fouled rate; surface actually required; duty; price.

METHOD: the compact, low-cost Royal Precision LGP-30 Electronic Computer.

INPUT DATA: except for special specifications which are handled by design engineers, non-technical personnel fill in data directly from customer inquiry sheets. This information is then punched on tape.



SOLUTION: the engineer reads the above data into storage in specifically assigned memory locations on the computer's magnetic drum. The set of program instructions–also stored on the drum–then directs the computer where to find the input data and what mathematical operations to perform in the proper sequential order. The program then further directs the computer to store the various answers in specifically assigned memory locations.

Of notable interest is the incorporated test feature which allows any type and arrangement of sections to be tested by the computer. The program not only compares calculated values, but provides a corrective computation and recomputes all conditions until satisfactory values are obtained. The engineer need only type in the exact arrangement desired to have the computer calculate his proposed arrangement – assuring complete versatility and control over the program.

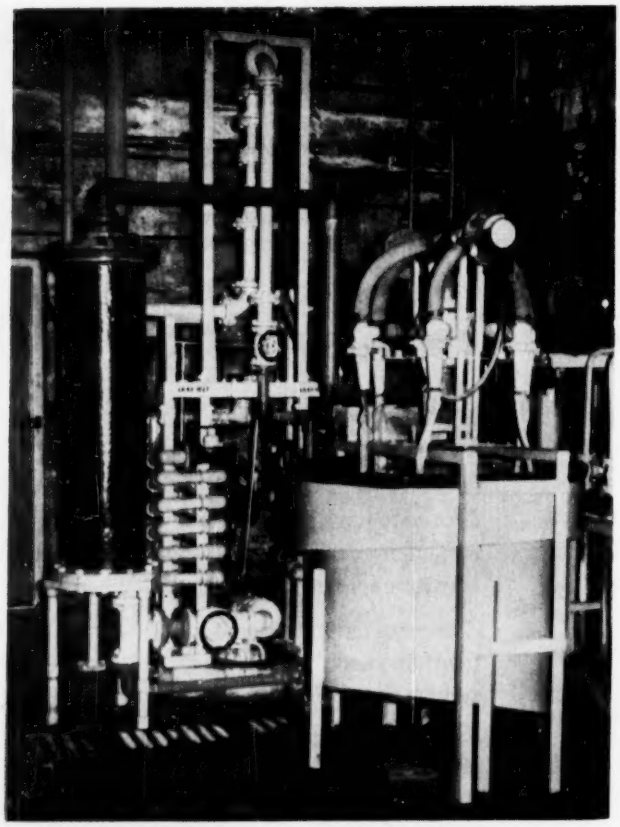
OUTPUT: all numbers required for the final specification sheet, including price, are provided – as well as key intermediate answers to enable the engineer to exercise judgment. The computer automatically controls the typewriter so that all answers are printed out in the desired format.



CONCLUSIONS: with the LGP-30, Brown Fintube has reduced total time on typical heat exchanger designs from one or two hours to approximately 3 minutes. Better design vs. cost combinations have been obtained–with a resulting increase in contract awards and the elimination of under-bidding. According to company officials, "perhaps the most significant contribution of the LGP-30 has been the release of engineering manpower for more basic and profound studies."

Royal Precision Corporation

Royal Precision is jointly owned by the Royal McBee and General Precision Equipment Corporations. LGP-30 sales and service are available coast-to-coast, in Canada and abroad through Royal McBee Data Processing offices. For your free copy of Application Report #10, as well as full specifications on the compact, mobile LGP-30, write today to **ROYAL McBEE CORPORATION,** data processing division, Port Chester, N.Y.



COMPACT forced circulation reactor, cyclone classifiers and settling chamber are located on mill operating floor.

duced further during subsequent settling in two 16,500-gal. storage tanks.

Cyclone underflow collects in a 200-gal. settling tank from which large lime particles and inerts are drawn off periodically. Overflow from this tank, containing finely suspended lime, flows into the recycle tank and thus through the reaction cycle again.

▶**Bleach Control**—Prime control point in the entire system is on hypochlorite line feeding into product storage tanks.

To hold a steady hypochlorite end point, a platinum-silver electrode pair measures the oxidation potential of product flowing through this line. This measurement is transmitted to an oxidation potential recorder controller which controls flow of chlorine to the reactor.

▶**Safety Extras**—Included in the BCFP plant are safety devices to protect both personnel and plant.

The dilute slurry storage tank serves secondarily as a safety blowdown tank for chlorine; its alkali capacity can absorb the total mill-system holdup in an emergency. For emergency evacuation of the chlorine system, the dilute slurry recycle flow can be diverted through a blowdown ejector which quickly pulls the chlorine vapors into the slurry tank.

Another safety device is based on heat of reaction generated in the process. Since each gram of chlorine formed will raise the temperature of one liter of solution 0.6 deg. F., final product concentration of 30 gpl. causes temperature to rise 18 F.

A temperature differential recorder-alarm, located in a circuit between the dilute lime slurry and the finished product, measures this temperature increase. It serves as a reliable check on the accuracy of lime dilution and warns of any malfunction in the automatic chlorine control circuit.

▶**Use Resistant Materials**—During the extended operating period, all materials of construction in the system have performed well. These include Saran-lined steel pipe for wet and dry chlorine service; corrosion- and fire-resistant Hetron polyester resin reinforced with fibrous glass, PVC and Saran or rubber-lined steel for various parts of reaction equipment and hypochlorite piping.

▶**Problem Licked** — Looking back at the operation, Allan H. Dowsley, bleach plant chemist, reports that only one serious problem developed. This was scaling of reaction and transfer piping at an unpredictable rate which is a function of carbonate and carbon dioxide content in the feed lime.

Solution worked out by Dowsley and Hooker engineers, after extensive field trials, led to present design of reaction and classification equipment. Now the scaling problem has been reduced appreciably by recent installation of forced circulation reactor, small cyclones and settling chamber.

However, the product is still somewhat milky. Further work to improve lime quality and reduce inert flocculent solids is aimed at producing a clear finished bleach liquor.

Nuclear Mining Could Lower Sulfur Cost

Detonation of a nuclear device within an underground sulfur deposit could melt the sulfur for recovery at a cost somewhat less than the present Frasch-process sulfur. Airing this view June 20th at joint meeting of AIChE and Instituto Mexicano de Ingenieros Quimicos in Mexico City, Southwest Research Institute engineers J. M. Dales and R. C. DeHart noted that production capacity might be limited only by hydraulic gradient around well and ability to raise sulfur.



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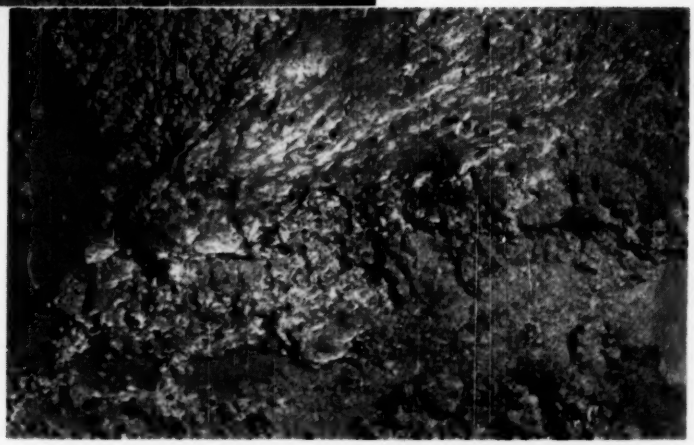
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PLASTIC ore-coal mass forms pellets under carefully controlled conditions inside Orcarb prereduction retort.



Effective new pelleting step promotes high prereduction of iron ore and lowers direct reduction cost.

Profits May Roll on Better Pellets

"Direct iron ore reduction scheme bypasses blast furnace." That headline isn't news any more. But how it's done is, and Swindell-Dressler Corp.'s Orcarb process (*Chem. Eng.*, April 18, 1960, p. 79) for recovery of pig iron from fine ore is a new twist on an old idea.

Orcarb process, developed by Pittsburgh consultant C. E. Lesher, bonds high-volatile coal and fine ore particles in homogeneous pellets. Intimate carbon-ore contact promotes high iron reduction (75-80%) in rotating kiln before the pellets go to an electric-arc furnace for final smelting.

Final reduction in the furnace to form pig iron thus requires less power than if the furnace feed was about 50% prereduced, which is a level typical of other processes. S-D says Orcarb process thus saves 500 Kwh./ton of pig iron produced.

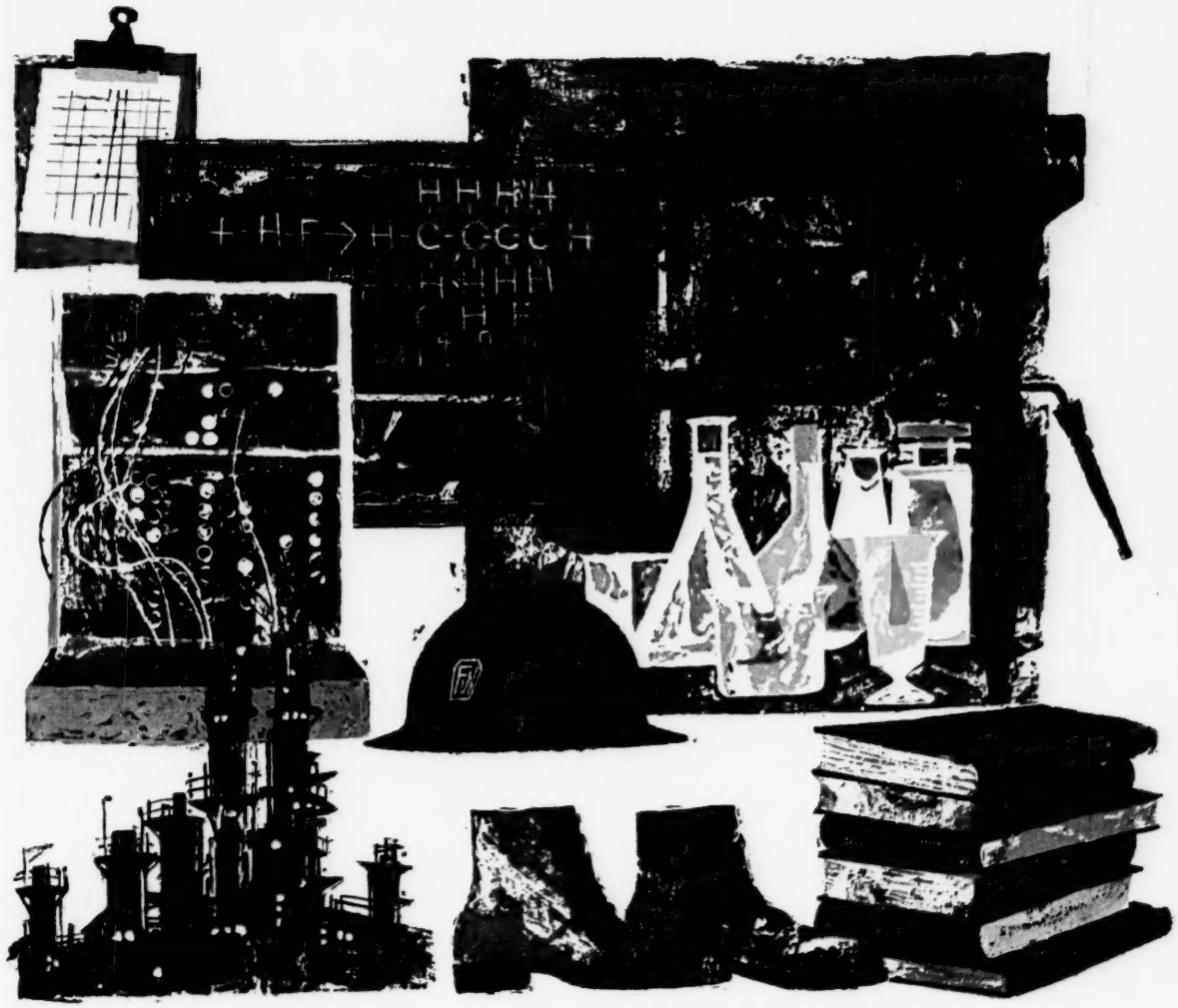
While it appears to be a direct competitor of the coke oven-blast furnace complex, Orcarb system could be a good supplement, consuming fine ore unsuitable for blast furnace use. Orcarb's easy start-stop feature gives system flexibility to handle varying fine ore supplies.

▶**Scaleup and Economics**—Present pilot plant produces 150 lb./hr. of pig iron. Swindell-Dressler says 2,000 ton/day Orcarb installation would cost about $25 million, or about half the investment needed for the same blast furnace capacity. Operating costs are expected to be about the same.

S-D has already designed a 200 ton/day unit. According to S-D engineers, scaleup to this size equipment poses no problems. Immediate target would be as blast furnace supplement or for foundries with large metal requirements.

Process is not limited to iron ore, says S-D. Orcarb technique can be used in any process requiring heat and carbon, such as processing of zinc, phosphate, and ferrous silicon.

▶**Heart of the System**—Key to the Orcarb process is the step that agglomerates the ore fines.



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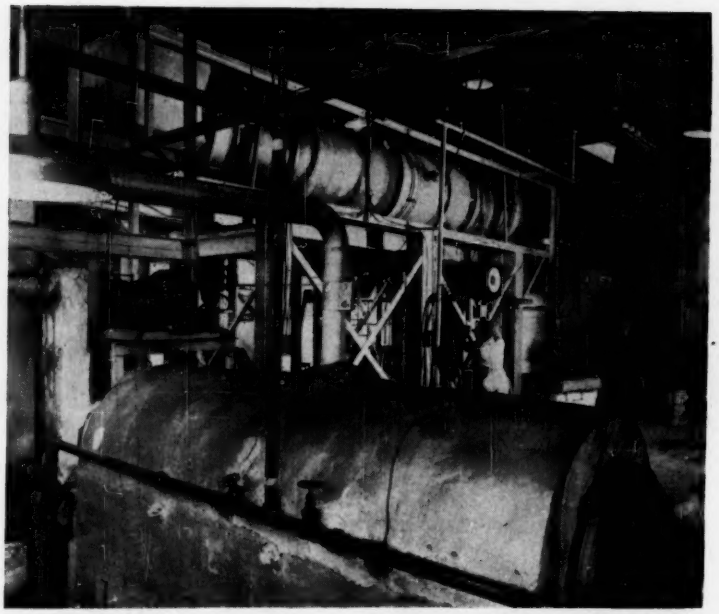
Two recent examples are plants delivered in good time and in good working order, operationally ready for quick write-off. They are a new ammonia plant producing in excess of 300 ton/day that exceeded rated capacity within 30 days of start-up; and a complete lube oil plant built in the Middle East which was in full production less than two years after award of the contract.

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CRITICAL pellet-forming takes place inside this Orcarb retort at Swindell-Dressler's 150-lb./hr. Indianola, Pa., pilot plant.

The operation consists simply of contacting preheated ore with high volatile coal in a rotating retort.

As the coal is heated, it melts, becomes plastic, and flows in intimate contact with the ore particles. Continued heating and tumbling solidify the coal-ore mixture into hard, porous pellets. Total residence time is 12-15 min.

Fine limestone or dolomite flux can be put into the pellets in the Orcarb step. Otherwise, flux is added to the pellets as they feed into the prereduction kiln. Here the intimate carbon-iron bond saves time and temperature in promoting fast and efficient iron reduction.

▶**Ore to Iron**—S-D operates continuous pilot plant at Indianola, Pa. Feed is fine ore, $-\frac{1}{4}$ in. and mostly −100 mesh, containing about 65% Fe (although any concentration of oxide ore will do). It is preheated to 1,100 F. in a counter-current, direct-fired gas heater. Hot ore then mixes with one-half its weight of fine high volatile coal to give a feed to the Orcarb unit containing about 40% carbon.

Coal-ore mixture enters Orcarb retort at 650-700 F. The steel-shelled unit, heated externally, moves the mixture at a peripheral speed of 90-100 ft./min. As mixture reaches 750-800 F., the coal becomes plastic and mixes with the ore.

Pellets form as the temperature increases to 850-950 F. Within 12 to 15 min. of entering the retort as fines, the agglomerated materials flow out as pellets. Gas and tar which form as by-products of the Orcarb step can be used as fuel for the preheating and Orcarb retorts.

▶**High Prereduction**—Orcarb pellets and flux feed into the prereduction retort at about 700 F., tumble around in a reducing atmosphere for about two hours, and leave the retort at 1,800-1,900 F. with 75-80% of the iron reduced to Fe. Heat for the reduction comes from the internal combustion of CO which is generated both in the prereducing retort and the furnace. Carbon coating on ore fines prevents their sticking to metal retort.

The once hard Orcarb pellets, now friable, dump into the electric arc furnace where reduction is completed. Molten iron and slag are tapped intermittently.

Soda Ash Expansion To Revamp Mining

A new way to mine trona will get its first tryout as part of a scheduled $4-million expansion of high-purity soda ash facilities at Intermountain Chemical Co. near Green River, Wyo. And possible application of the method to underground mining of phosphate rock has excited comment among Western mining and chemicals industries.

By using augers, adapted from hard-coal mining, Intermountain Chemical has developed a continuous system for mining, extraction and movement of trona which eliminates all blasting and drilling underground.

In conjunction with mining changes, the expansion program will incorporate refinements to refinery technology, based on the basic Pike patents covering the existing process. As the result of a cash deal, Intermountain now owns these patents under which it has been paying royalties.

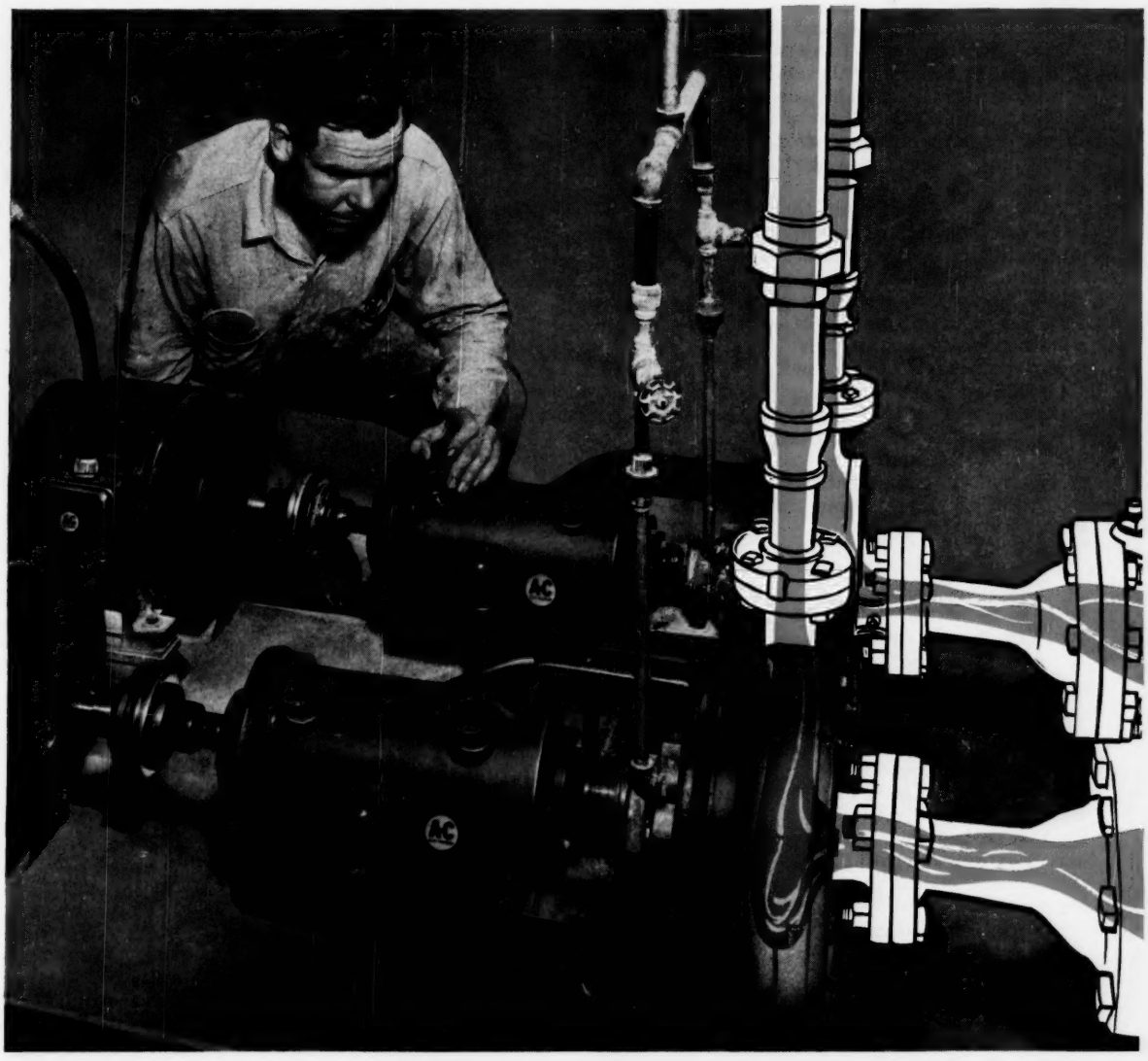
Combined mining and refinery changes will boost output 200,000 tons to 720,000 tons/yr. by early 1962 when the second phase of expansion is finished.

High-Speed Encapsulating Device Moves Out of Lab

Southwest Research Institute (San Antonio, Tex.) has completed design and started construction of its new mass-production, high-speed encapsulation machine (*Chementator*, May 2, p. 58). A multi-orifice apparatus, unit will be capable of turning out capsules 100-micron dia. at the rate of 90,000/sec. SwRI describes this machine as a laboratory scale model, maintains that the principle by which it works can be stepped up into a production model of "far greater output."

In machine, fluid film material (shell-forming material) is fed into grooves above and below a row of orifices located around the periphery of a horizontally rotating basket. Overflow from these grooves feeds into the chamfered orifices themselves,

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To meet precise job requirements, corrosion and temperature conditions, various materials of construction are available . . . cast iron, bronze, stainless steel, and other alloys. Impeller may be open or enclosed, bearing lubrication either oil or grease. And to be sure of the right sealing arrangement, you can choose from a variety of stuffing box arrangements, including packing or mechanical seals.

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A-1273

forms membrane films across them. Liquid filling material is fed into center of a concentrically counter-rotating disk and is carried by centrifugal force to the film material membranes. There individual capsules are formed. Capsules then fly into a circulating hardening bath from which they are removed by screens.

SwRI reports that more than 100 organizations have expressed interest in and discussed possible application of this machine. Much of the Institute's work with the apparatus has had a military orientation (e.g., liquid rocket propellants). But SwRI visualizes wide industrial application as well. Apparatus provides a means of combining chemically incompatible materials and a convenient, safe method of storing and handling hazardous materials.

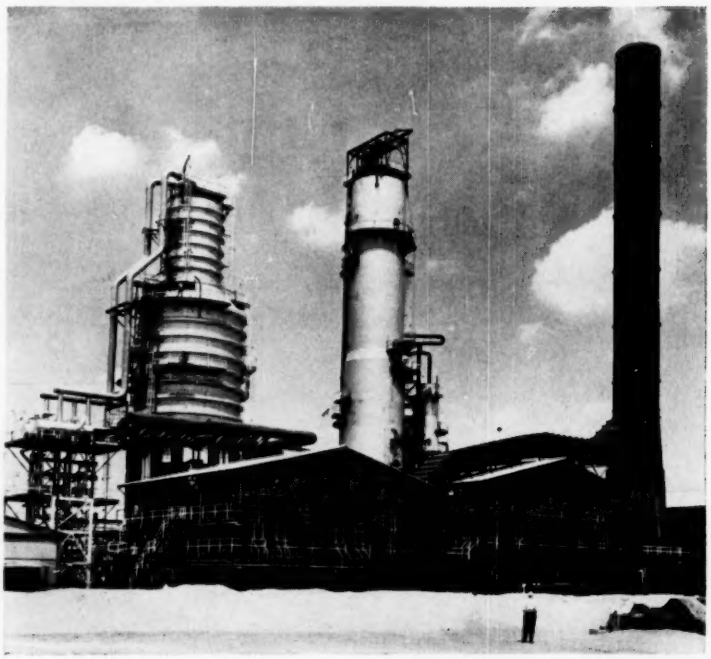
Liquid Hydrogen-Nuclear Rocket Work Advances

Advanced work on Project Rover—Air Force-AEC development of a nuclear rocket engine using liquid hydrogen as its fuel —is now getting underway.

Air Products, Inc. (Allentown, Pa.), project's prime contractor, announced last month that construction has started at Jackass Flats, Nev., on the first facility designed to introduce liquid hydrogen into the Rover propulsion system. Until now, Project Rover work has concentrated solely on the reactor portion (KIWI-A) of the system. Called Test Cell C, facility, to be in operation next year, will serve to test the feasibility of generating propulsion energy for a missile by vaporizing liquid H_2 with nuclear heat.

This propulsion technique, note industry observers, promises to deliver a specific impulse vastly superior to any other propellant system currently available or under study. For example, the liquid hydrogen-liquid oxygen system planned for such advanced missiles as Saturn and Centaur is expected to deliver about 385 lb. A Project Rover engine is reliably reported to be able to pack an 800-lb. punch.

INDUSTRY NEWS



CRUDE STILL at Whiting, Ind., gets heat from three huge furnaces.

Standard Oil Co. (Ind.) has put on stream the crude oil pipe still pictured above. Billed as the world's largest, the Whiting, Ind., unit has a design capacity of 140,000 bbl./stream day. It replaces nine older stills, thus lowering operating costs and giving the refinery more flexibility in manufacturing gasolines.

Monochem, Inc., is a new chemical company formed by The Borden Co. and U. S. Rubber Co. as part of a $50-million joint venture in hydrocarbon processing. Monochem will build a plant to convert hydrocarbons into acetylene and vinyl chloride monomer; Borden and U. S. Rubber will probably build adjacent, individually-owned plants to convert the Monochem output to other products. The two companies have been considering several Gulf Coast sites for the Monochem facility, and construction will start this year.

When the plant is completed (tentatively in 1962) it will be able to produce over 80 million lbs./yr. acetylene, about 150 million lbs./yr. vinyl chloride.

Florida Development Commission has announced that several sites in the northwestern part of the state are being considered for a nuclear fuel reprocessing plant. The name of the interested company was not disclosed. Plant would cost $12,000,000 to $20,000,000, and would treat fuel elements from privately-owned nuclear power plants. It would require about 6,000 acres of land. The Commission has employed Holmes & Narver, Inc., a California nuclear engineering firm, to make a study of the plant from a safety standpoint.

Industry News continues on page 152.

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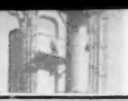
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Lineup for the Series

1. **Petrochemicals Map Their Mature Years, May 30, p. 54**
2. Chemicals From Methane
3. Ethylene Chemicals
4. Propylene and Butylene Chemicals
5. Aromatics

Petrochemicals 2

Chemicals From Methane

Here analyzed are shifts in source and end use of ammonia, acetylene and derivatives, methanol, chloromethanes, carbon disulfide, hydrogen cyanide.

Richard F. Messing and James W. Bradley, Arthur D. Little, Inc.*

The most important route for conversion of methane to petrochemicals is via hydrogen or hydrogen and carbon monoxide (synthesis gas), formed by steam re-forming or partial oxidation. In addition to hydrogen and carbon monoxide from natural gas and liquid hydrocarbons, refinery hydrogen, hydrogen from the partial oxidation of petroleum, coke-oven gas, and to a lesser extent electrolytic hydrogen are used. Refinery hydrogen's share will decrease as refinery hydrogen is increasingly committed for refinery use, and refiners, usually unwilling to commit byproduct hydrogen on a long-term basis for petrochemical production.

Ammonia Demand Catching Up With Capacity

Ammonia is the largest volume petrochemical and is produced in over fifty-five plants, more than any other petrochemical. The 1959 synthetic production, 4.5 million tons, represented 18-19% of total petrochemical production in that year. Estimated current capacity, including that under construction, is 5.0 million tons, although this rated figure could be exceeded substantially, if demand warranted. If only capacity-in-place during 1959 is considered, 1959 production was over 90% of rated capacity, a sharp change from the overcapacity of past years. This shift has been reflected in generally firmer pricing and even some seasonal shortages for nitrogen products. The West Coast situation is an exception to this generally improving relationship between demand and supply in view of the extensive plant construction in that area.

▶ **Decentralization**—Comparing location of older synthetic-ammonia plants with some of those more recently constructed dramatizes the shift in location which has taken place. Older plants were located primarily in the Gulf where cheap natural gas was available. In recent years, the tendency has been to locate closer to the market, especially in fertilizer, which is showing the strongest growth in the north central states. The capability of a producer to provide better service in nearby areas, coupled with relatively high freight costs and a relatively low selling price, has dictated this change.

Another factor permitting geographical diversification has been the availability of byproduct hydrogen from some petroleum refineries and the partial oxidation process which allows the use of liquid hydrocarbons (in addition to methane) as a source of hydrogen. The extension of natural-gas pipelines also has been a major factor.

▶ **Direct Application** — A significant change in the U. S. synthetic-nitrogen picture has been the increasing percentage of nitrogen applied directly to the soil as anhydrous ammonia, nitrogen solutions, or in solid form rather than being incorporated in or used by the mixed-fertilizer

* For authors' biographies, see *Chem. Eng.*, May 30, 1960, p. 54.

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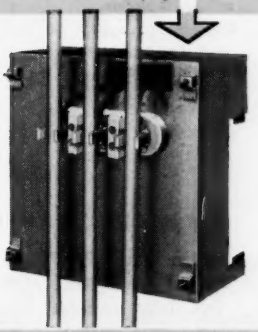
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manufacturer in mixed fertilizers. In fact, the primary market for synthetic nitrogen can no longer be said to be in mixed fertilizers.

▶ **New Market Pattern** — This shift towards direct application has changed marketing patterns of both the ammonia producers and mixed-fertilizer companies. The latter are tending to integrate back towards ammonia to participate in this agricultural market, as evidenced by Armour Fertilizer's recent acquisition of Mississippi River Chemical, construction of an ammonia plant by Tennessee Corp. (partly for diammonium phosphate for direct application and bulk blending). Some of the incentive of course is provided by the cost savings of integrated nitrogen manufacture, particularly if captive plants can be run at or near capacity.

In 1959 over 60% of the agricultural nitrogen was used for direct application. Synthetic nitrogen producers are having to produce a variety of nitrogen materials for direct application. The greatest growth in this market has been by anhydrous ammonia and nitrogen solutions rather than the solid forms. Nevertheless, the growth of direct-application nitrogen, solid and solution, has forced production and sale of ammonium nitrate and urea both as solids and as components of solutions.

▶ **Industrial Use Outpaced**—Industrial uses of synthetic nitrogen have not kept pace with agricultural demand, and agriculture's market share of ammonia production has continued to increase. Ammonia pulping and most other newer uses have proved disappointing.

Ammonium nitrate-oil mixtures continue to capture a larger share of the explosive and blasting-agent market against conventional (but nevertheless nitrogen-containing) explosives. The latter often contain 80% or more nitrate but cannot compete in cost with field-mixed ammonium-nitrate prills (plus about 6% oil) at about 5¢/lb. Ordinary fertilizer-grade prills, which are not subject to the transportation and storage costs and hazards of manufactured explosives, are often used. Reported total ammonium-nitrate consumption for explosives in 1958, including that in field-mixed explosives, was 321,000 tons, or 67% of all materials used in explosives. Because there exists some unreported quantities of fertilizer prills used as explosives, this figure may even be conservative. Nitrate-oil mixtures have begun to find use in underground mining, particularly potash and salt in addition to already well-established above-ground use.

Methanol Shows Conservative Growth

Largest outlet for synthesis gas per se is synthetic methanol. Here methane (natural gas) is converted to synthesis gas by a re-forming or partial-oxidation step. Two newer plants use off gases from acetylene, which will probably also be basis for some further capacity. Method is of special interest when co-products can be used or marketed advantageously. Compared to ammonia, methanol growth from 1950 to 1959 has been minor, averaging 5.8%/yr. vs. about 10.5% for ammonia.

Synthetic Methanol End-Use

(Million gallons)

End Use	1959 (Est.)
Formaldehyde	115
Automotive antifreeze	13
Aircraft military & civilian	11
Exports	17
Methyl methacrylate, acrylate, & methyl amines	15
Misc.	96
	267

The major end use for methanol is in making formaldehyde, principally for the manufacture of phenolic, urea, and melamine resins. Antifreeze use has largely faded in favor of ethylene glycol, accounted for only 13,000,000 gal. of methanol in 1959.

▶ **New Formaldehyde Market**—Du Pont recently commercialized Delrin, a polyformaldehyde resin derived from formaldehyde. This resin may develop into a significant formaldehyde market. Delrin's market is expected to be largely as a replacement for die-cast metals. It's the first potentially important new formaldehyde derivative in several years.

While most formaldehyde is produced by the oxidation of methanol, considerable output is based on the direct oxidation of hydrocarbons. The Oxo-alcohols, which require carbon monoxide and hydrogen (synthesis gas) plus olefins in their production, are discussed in a subsequent section.

Acetylene: Scheduled Boom Has Not Arrived

The expected boom in hydrocarbon acetylene (or chemical acetylene in total, for that matter,) has failed to reach levels predicted a few years ago. Acetylene production for chemical synthesis in 1959 totaled 706 million lb. compared to total ethylene production of more than 4.5 billion lb. Growth in the last decade averaged 7.5% per year vs. 11% for ethylene.

The price of acetylene (about 11-13¢/lb. vs. 5¢ for ethylene) has been the greatest deterrent to growth and has encouraged, where feasible, the use of alternate hydrocarbons for chemical synthesis. Several chemicals expected at one time to boost chemical-acetylene demand have not lived up to expectations, although these have been offset in part by growth of others. Methyl-styrene production was abandoned by American Cyanamid; acrylonitrile is being expanded by the propylene-ammonia process; acrylates are shifting from ethylene oxide to acetylene.

Hydrocarbon-derived acetylene has proved to be economic in areas of low natural-gas costs, but expansion of chemical-acetylene facilities elsewhere (for example, Calvert City, Ky.), has involved the calcium-carbide route. An important factor is

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Fig. 2453SG—Large Stainless Steel O. S. & Y. Gate Valve for 150 W.P. Fully guided solid wedge disc. Also available with interchangeable split wedge disc — Fig. 2453DG.

Fig. 2433SS — Large Stainless Steel Swing Check Valve for 150 W.P. Bolted flanged cap. Integral seat. Teflon disc and renewable seat ring are available on special order and at extra price.

Fig. 2309—Large Flush Bottom Tank Valve for 150 W.P. Designed for fast draining. Disc opens into tank. Also available with disc opening into valve — Fig. 2310.

Fig. 2107 — Small Stainless Steel "Y" Valve for 150 W.P. Flanged ends, but can be supplied with screwed or socket welding ends. Dimensions conform to latest standards.

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that investment per pound of acetylene capacity by the carbide process is less than from natural gas.

▶ **12% From Hydrocarbons** — Total 1959 acetylene production (exclusive of that from portable generators) was 831,000,000 lb., of which 83% was for chemical manufacture. Production from hydrocarbons was about 12% of total production. Locations of all hydrocarbon-acetylene capacity are in the Gulf natural-gas-producing area and are based on the oxidative cracking of natural gas. Acetylene output from none of these plants is believed to have reached design capacity.

▶ **In Neoprene** — Neoprene historically has always been the largest market for acetylene, although in 1959 vinyl-chloride monomer was essentially equal to neoprene as an acetylene consumer. Neoprene, produced only by Du Pont, has grown moderately, with 1959 production amounting to 280,000,000 lb.

▶ **In Vinyl Chloride** — An estimated 55% of vinyl-chloride-monomer production in 1959 was manufactured from acetylene, and a balance seems to have been struck between the acetylene and ethylene processes. The principal factor in choice of process at a given location is the balance between chlorine and hydrogen-chloride demand.

▶ **In Acrylonitrile** — The third largest market for acetylene is acrylonitrile. Acrylonitrile production in 1959 totaled 232,000,000 lb., about 80% of which was derived from acetylene. Two plants under construction, Standard Oil of Ohio and Du Pont, however, will utilize a process based on ammonia and propylene, a route that the industry views as having considerably more favorable economics.

Capacity for acrylonitrile now in place or under construction exceeded 1959 demand by more than 250,000,000 lb. Capacity is being augmented not only to serve the more prosaic but still growing rubber and plastic uses but also the more dynamic area of acrylic fibers—Orlon, Acrilan, Dynel, Verel, and Zefran; alleviation of acrylonitrile overcapacity depends on progress of these fiber markets.

▶ **In Vinyl Acetate** — Of total vinyl-acetate-monomer capacity, all except the unit of Celanese Corp. are based on acetylene. Vinyl acetate has found increasing acceptance in paint and adhesives, with both indoor and outdoor latex finishes achieving substantial volume.

▶ **In Trichloroethylene** — Trichloroethylene is the last of the major acetylene derivatives. All production is derived from acetylene. Vapor degreasing and perchloroethylene manufacture are the dominant markets, although direct-hydrocarbon chlorination is replacing the trichlor route to perchloroethylene. Miscellaneous chemical end uses of acetylene include "Reppe" chemicals, produced by General Aniline & Film at Calvert City.

Hydrocarbon Acetylene Capacity

(Million pounds)

Producer & Location	(Est.)
American Cyanamid Fortier, La.	70
Dow Chemical Freeport, Tex.	50
Monsanto Chemical Texas City, Tex.	50
Rohm & Haas La Porte, Tex.	50
Union Carbide Texas City, Tex.	50
	270

Acetylene End-Use

(Million pounds)

End Use	1959 (Est.)
Vinyl chloride monomer	205
Neoprene	205
Vinyl acetate monomer	58
Acrylonitrile	114
Trichloroethylene	80
Misc. chemical uses	44
Subtotal	706
Nonchemical	125
	831

Vinyl Acetate Monomer Capacity

Producer & Location	Capacity (Est.)
Air Reduction Chemical Calvert City, Ky.	90 (incl. 45*)
Celanese Corp. Pampa, Tex.	50[a] (incl. 20*)
Du Pont Niagara Falls, N. Y.	30
Union Carbide Niagara Falls, N. Y.	30
Texas City, Tex.	65
Total U. S. Capacity	265
Shawinigan Chemicals Shawinigan Falls, P.Q., Canada	40[b]
Total U. S. & Canada	305

* Under construction.
(a) Not based on acetylene.
(b) Largely for U. S. consumption.

Vinyl Acetate End-Use

(Million pounds)

End Use	1959 (Est.)
Vinyl acetate resins	115
Polyvinyl butyral, acetal & formal	45
Polyvinyl alcohol	40
Other polymers & misc.	10
	210

Acrylonitrile Capacity

(Million pounds)

Producer & Location	Capacity (Est.)	Route
American Cyanamid Fortier, La.	100	Acetylene
Dow Chemical Freeport, Tex.	30*	Acetylene
Du Pont Memphis, Tenn.	60*	Acetylene
Beaumont, Tex.	50*	Ammonia-Propylene
Goodrich Chemical Calvert City, Tex.	35	Acetylene
Monsanto Chemical Texas City, Tex.	100	Acetylene
Sohio Chemical Lima, Ohio	40*	Ammonia-Propylene
Union Carbide Institute, W. Va.	70	Ethylene Oxide
	485 (incl. *)	

* Under construction.

Acrylonitrile End-Use

(Million pounds)

End Use	1959 (Est.)
Fibers	135
Rubber	34
Plastics	25
Misc. & exports	38
	232

Trichloroethylene Capacity

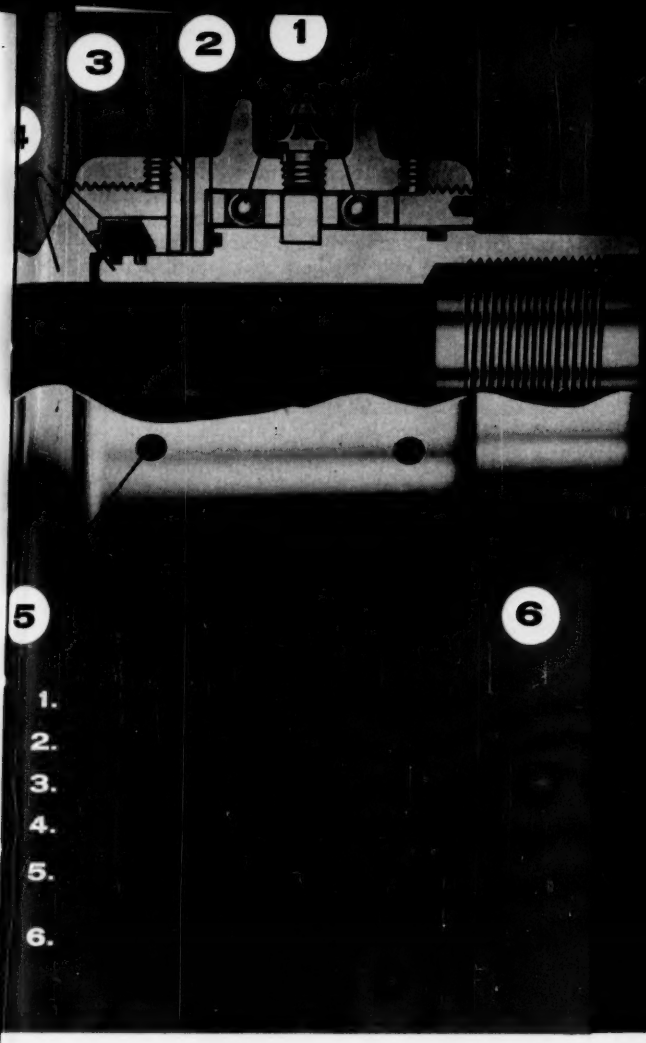
(Million pounds)

Producer & Location	Capacity (Est.)
Columbia Southern Chemical Barberton, Ohio	40
Detrex Chemical Industries Ashtabula, Ohio	80
Dow Chemical Freeport, Tex.	30
Du Pont Niagara Falls, N. Y.	170
Wyandotte, Mich.	70
Hooker Chemical Niagara Falls, N. Y.	30
Wyandotte, Mich.	40
	460

Trichloroethylene End-Use

(Million pounds)

End Use	1959 (Est.)
Vapor degreasing	298
Extraction	6
Perchloroethylene	49
Misc.	9
	362



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Chloromethanes Grow Via Fluorocarbons

The chloromethanes are all made by two or more processes, only one of which involves direct chlorination of methane. Growth has come via fluorocarbons.

For carbon tetrachloride (360,000,000 lb. for 1959), 86% of consumption was for making trichloro-monofluoromethane and dichlorodifluoromethane. While markets in fluorocarbons are growing, carbon tetrachloride has been supplanted in some solvent markets. Chloroform production in 1959 was 60,000,000 lb. About half was used to make monochlorodifluoromethane, a part of which was converted to Teflon fluorocarbon resin. This material is expected to meet increasing competition from other types of high-performance resins. For methylene chloride (1959—95,000,000 lb.), paint and varnish removers remain the most important market. Use as a component in safety solvents and as an aerosol propellant have grown rapidly. Methyl chloride (1959—50,000,000 lb.) has its major application in the synthesis of silicones.

Carbon Tetrachloride Capacity

(Million pounds)

Producer & Location	Capacity (Est.)	Route
Allied Chemical Moundsville, W. Va.	5	Methane
Columbia Southern Chemical Barberton, Ohio	20	Perchloroethylene Co-Product
Diamond Alkali Painesville, Ohio	60	Carbon Disulfide
Dow Chemical Freeport, Tex. Plaquemine, La.	100	Methane Perchloroethylene Co-Product
Pittsburg, Calif.	30	Methane, Perchloroethylene Co-Product
Food Machinery & Chemical S. Charleston, W. Va.	50	Carbon Disulfide
Frontier Chemical Wichita, Kan.	15	Perchloroethylene, Co-Product Methane
Stauffer Chemical Niagara Falls, N. Y.	100	Carbon Disulfide
Louisville, Ky.	20	Methane, Perchloroethylene Co-Product
	400	

Methyl Chloride Capacity

(Million pounds)

Producer & Location	Capacity (Est.)	Route
Allied Chemical Moundsville, W. Va.	12	Methane
Ansul Chemical Marinette, Wis.	18	Methanol
Diamond Alkali Belle, W. Va.	8	Methane
Dow Chemical Freeport, Tex.	20	Methane
Pittsburg, Calif.	10	Methane
Dow Corning Midland, Mich.	20	Methanol
Du Pont Niagara Falls, N. Y.	20	Methanol
General Electric Waterford, N. Y.	10	Methanol
Kolker Chemical Newark, N. J.	14	Methanol
	132	

Methylene Chloride Capacity

(Million pounds)

Producer & Location	Capacity (Est.)	Route
Allied Chemical Moundsville, W. Va.	15	Methane
Diamond Alkali Belle, W. Va.	10	Methane
Dow Chemical Freeport, Tex.	40	Methane
Pittsburg, Calif.	10	Methane
Du Pont Niagara Falls, N. Y.	25	Methanol
Frontier Chemical Wichita, Kan.	10	Methane
Kolker Chemical Newark, N. J.	10	Methanol
Stauffer Chemical Louisville, Ky.	20	Methane
	140	

Chloroform Capacity

(Million pounds)

Producer & Location	Capacity (Est.)	Route
Allied Chemical Moundsville, W. Va.	8	Methane
Brown Company Berlin, N. H.	5	Methanel
Diamond Alkali Belle, W. Va.	5	Methane
Dow Chemical Freeport, Tex.	30	Methane
Pittsburg, Calif.	5	Methane
Du Pont Niagara Falls, N. Y.	10	Methanol
Frontier Chemical Wichita, Kan.	5	Methane
Kolker Chemical Newark, N. J.	5	Methane
Olin Mathieson (Squibb) New Brunswick, N. J.	5	Acetone & Bleaching Powder
Stauffer Chemical Louisville, Ky.	10	Methane
	88	

Carbon Disulfide and Hydrogen Cyanide

Carbon disulfide historically has been manufactured from sulfur and carbon. Recent plants, however, utilize a process involving the direct reaction between methane and sulfur. Major carbon disulfide markets are restricted to viscose rayon, cellophane, and carbon tetrachloride, although volume used in some of the newer pesticides is increasing.

The last important derivative of methane is hydrogen cyanide, formed by direct reaction between ammonia and methane.

Market growth has paralleled the increased volume of manufacture of derivatives, particularly adiponitrile, acrylonitrile, ethylene cyanohydrin for acrylates and acetone cyanohydrin for methacrylates.

Recent process developments have somewhat altered the outlook, as exemplified by the propylene-ammonia process for acrylonitrile and the direct conversion of acetylene to acrylates by a Reppe synthesis.

The development of new routes to caprolactam involving oxidation of a hydrocarbon may also accelerate the growth of Nylon 6, which will in turn prejudice the future potential for use of cyanides in making adiponitrile. The successful completion of development work on isobutylene oxidation to make methacrylates would also tend to displace hydrogen cyanide from this market.

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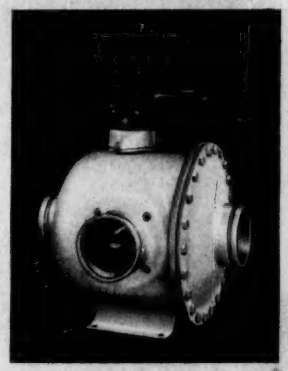
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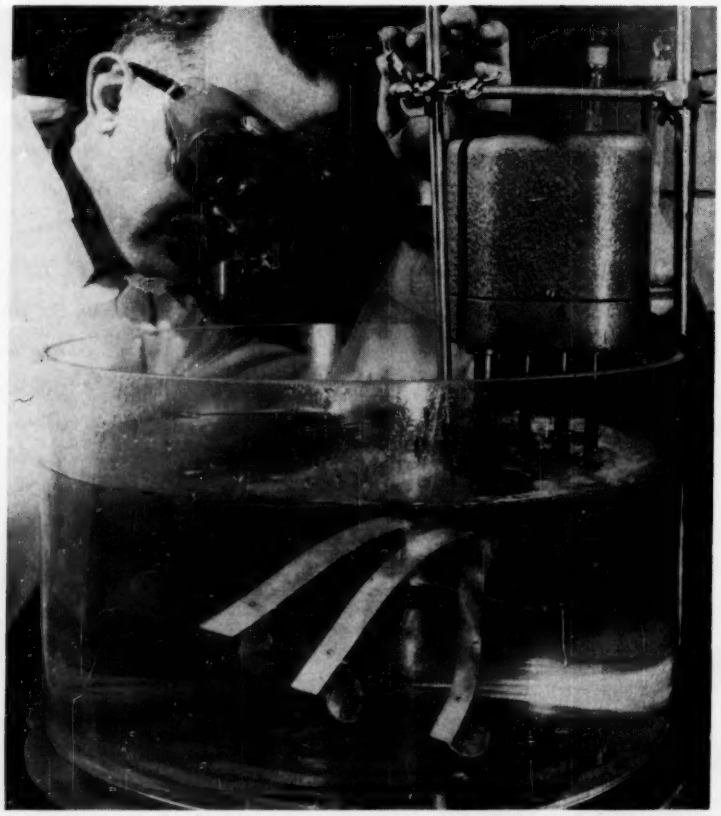
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HI-TEMP GEON, left, shows no sag in 180-F. water bath. Other strips are conventional vinyl, high-density polyethylene and polyamide.

New Vinyl Withstands 200 F.

High-temp factor means vinyl can take over functions previously in exclusive domain of metals.

A new polyvinyl dichloride that can withstand temperatures 60 degrees higher than conventional vinyls is being touted by B. F. Goodrich as "the first significant breakthrough in the industry since the development of the first rigid vinyl 12 years ago."

Called hi-temp Geon, the new material makes possible the use of vinyl, for the first time, in applications where only metals have held sway.

Not only does hi-temp Geon retain all the advantageous properties of conventional vinyl (strength, light weight, corrosion resistance), but it also has these points in its favor:

- Stands up under 200 F.—60 degrees higher than is possible in conventional rigid vinyl.
- Won't support combustion and is rated as self-extinguishing by ASTM.
- Has sufficient impact strength and resilience to absorb shock and stresses found in field handling installations.

Pipe made of the new material can handle pressures as high as 100-160 psi. at 180 F., and several times that at normal temperatures. Its unique properties make it practical for applications such as handling hot acid solution under extreme temperatures and pressures.

In industrial testing, hi-temp Geon has passed tests of contact with 98% sulfuric acid at 185 F. for 30 days—something never before achieved with a vinyl compound.

Low thermal conductivity of high-temperature Geon pipe reduces heat transfer, thus reduces moisture condensation on the outside of cold water lines and helps to maintain the temperature of hot or cold liquids carried through the pipe.

Pipe made of the new vinyl can be joined with socket solvent cemented joints or threaded couplings, and can be cut with an ordinary saw and formed to desired curvatures by heating.

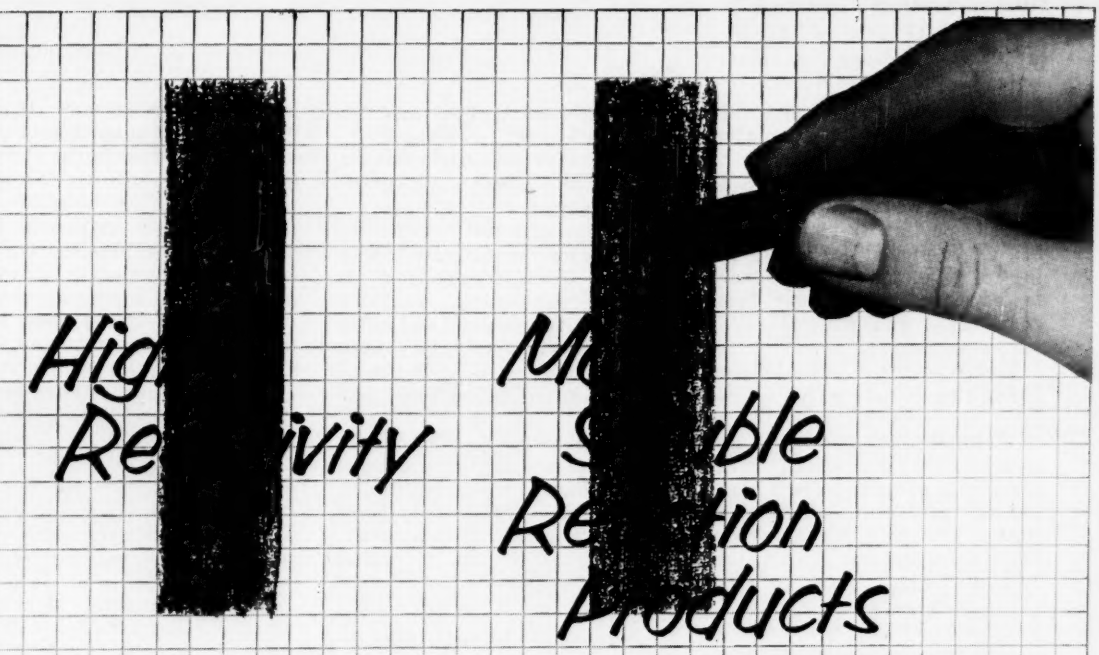
Potential markets for hi-temp Geon include pipe and fittings, shaped piping and ducting, missiles and rocketry, household appliances, automotive parts.

Products made from this new material can be produced on existing plastic-processing equipment.—**B. F. Goodrich Chemical Co., New York.** **82A**

UV Absorber

Light-stabilizes polyolefin plastics.

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Its high reactivity is also useful in mercaptan extraction and desulfurization of petroleum products. Caustic potash solutions effectively absorb carbon dioxide and hydrogen sulfide in industrial gases. Dry forms are highly hygroscopic, excellent for dehydration.

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to make new products for building, agricultural, automotive and marine applications.

Trademarked Cyasorb UV314, the absorber is the first one designed specifically to light-stabilize polyolefin plastics. During its development it has been tested extensively under both accelerated and natural exposure conditions.

Test results for polyethylene, containing as little as 0.5% Cyasorb and exposed to sunlight in Arizona for four months, are as follows: Low-density poly retains 60% elongation, and high-density poly retains 88% elongation. Without the absorber, both polyethylenes become extremely brittle within 1-3 months' exposure.

Chemically 2,2'-dihydroxy-4-*n*-octoxybenzophenone, Cyasorb UV 314 is a pale yellow powder that absorbs strongly the 300-375 millimicron range of the ultraviolet spectrum. Its long alkyl group at the ether linkage makes it compatible with polyolefins. After four months exposure in Arizona, for instance, about 90% of the absorber remains in the polyethylene. This contrasts with other commercially-available absorbers, which are fugitive and migrate out of the plastic.

Applications of plastics fibers light-stabilized with Cyasorb UV 314 include marine ropes, fabrics for lawn furniture, and fabrics for automotive and household upholstery. Typical film and sheeting applications are mulch or greenhouse sheeting, high-altitude balloons and irrigation tubes. — **American Cyanamid Co., New York.** 82B

Synthetic Rubber

Fluorosilicone sponge resists fuels, lubricants.

COHRlastic 10530, a fluorosilicone sponge rubber with a dense, uniform non-absorbing closed cell structure, shows excellent resistance to fuels and lubricants at very high temperatures.

In addition, the new rubber is immune to aging, ozone and weather hardening, and it has good dielectric properties and compression set resistance.

Like other silicone rubbers, 10530 exhibits only slight property changes over a temperature range of −100 F. to 500 F.

The new sponge is highly suitable for soft gasketing, vibration dampening, fairing strips, pads, cushions and other uses where there is very high or low temperature with simultaneous exposure to fuels and oils.

The material is available in 12x12 in. and 24x24 in. molded sheets, having thicknesses of $\frac{1}{8}$, $\frac{3}{16}$ or $\frac{1}{4}$ in. — **Connecticut Hard Rubber Co., New Haven, Conn.** 84A

Cryogenic Insulation

Bars heat in storage of volatile liquids.

Standard Steel Corp. has been licensed by National Research Corp. to use new NRC-2 cryogenic insulation in making vessels, with extremely long hold times and minimum pressure buildups, for storing liquid helium, liquid hydrogen, liquid fluorine and other liquefied gases with ultra-low boiling points.

NRC-2 is a multiple barrier reflective insulation for operating under high vacuum. It provides an efficient method of preventing heat flow in the storage and transport of ultra-low-temperature, highly volatile liquids. And, its extremely low density makes possible a considerable reduction in the overall weight of a storage vessel.

Results of various tests, confirmed by government and university laboratories, indicate that the new insulation has the lowest heat transfer coefficient known to be available. A recent series of tests with NRC-2 produced "k" factors as low as 0.1618×10^{-4} Btu./(hr.) (sq. ft.) (°F./ft.) between room temperature and liquid nitrogen temperature.

In comparisons of equal thicknesses of NRC-2 and 80-mesh evacuated perlite (a widely used insulation), perlite was found to have 35.7 times more heat leak than NRC-2. (And, perlite weighs 3.48 times more than NRC-2.)

The extremely low heat loss of NRC-2 insulation makes it possible to store such hard-to-contain liquid gases as liquid helium and liquid hydrogen for extended periods with a minimum loss. The material can do away with the need for a costly extra protective jacket of nitrogen. This factor alone can net considerable savings in opera-

Newsworthy Chemicals

Page Number is also Reader Service Code Number

New vinyl may move in on metals..... 82A
UV absorber tailor-made for polyolefin plastics..... 82B
Fluorosilicone rubber immune to fuels and lubricants... 84A
Cryogenic insulation helps store volatile liquids..... 84B
Chemical sieve material controls urethane-foam molding 86A
Rocket propellant can be easily formulated and prepared 86B
Polyglycols now added to Vibrathane group..... 86C
Phenolic resin permits rapid production..... 86D
Defoamer ready to aid pulp and paper industries..... 86E
Isosorbide, chemical intermediate, now available..... 86F
Trimellitic anhydride takes on improved form, lower price 86G

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tion and maintenance of storage equipment. — **Standard Steel Corp., Los Angeles.** 84B

Chemical Sieve

Promises to boost use of rigid urethane foams.

Problem: How can you slow down the start of foaming in rigid urethane foams, so that the foam will reach all parts of the mold into which it is sprayed?

Solution: Chemical Loaded Molecular Sieve CW-4107.

The new chemical sieve is a combination of an active organo-tin catalyst with a zeolite material. It delays the start of foaming by as much as 1-2 min. after spraying. But once foaming starts, it takes place as quickly as it would without the sieve.

The catalyst is released from the sieve by chemical action or by heat. Its release triggers the foaming action.

This new development is expected to contribute to the growing use of rigid urethane foams as insulation and reinforcement. — **Linde Co. Div., Union Carbide Corp., Tonawanda, N. Y.** 86A

Rocket Propellant

Vinyl-based solid gives power, reliability.

Via a plastisol technique, a mud-like slurry of vinyl resin, plasticizers, aluminum powder and ammonium perchlorate is converted into a powerful, reliable solid fuel propellant.

Developed by Atlantic Research Corp., the propellant powers several rockets, among which are the Arcon and Arcas, high-altitude meteorological probes, as well as the PET (for propellant, experimental test), a pocket-size rocket engine that performs spin and retro functions on large rockets and missiles.

When heated to 350 F., the plastisol fuses into a rubbery, tough material. As a binder and fuel in the missile, it locks the various components into a homogeneous mass with a long service life. The unplasticized mixture stores well, allowing great latitude in experiment and formulation.

By modifying ingredients, rocket fuels may be produced for temperature extremes ranging from −80 F. to 250 F. Aluminum powder added to the mixtures gives the rocket a sharp boost in power.

Among the advantages offered by the plastisol method of solid fuel preparation are: fast, economical processing, allowing a large through-put in a relatively small plant; and easy shaping and sizing of the fuel mass for a particular rocket application.

Atlantic Research presently uses a casting process to produce the solid fuel propellant. Raw mix is put into a mold which is steam heated through the outer jacket, and, usually, the inner mandrel.

The mold shapes the mix to the design required for a particular rocket. Remotely operated valves shut off the steam and introduce cooling water. The formed propellant charge is then removed, trimmed and prepared for use.

Atlantic also has, in an advanced development stage, a continuous extrusion process based on a modified commercial machine. — **Atlantic Research Corp., Alexandria, Va.** 86B

BRIEFS

Polyglycols, major components of urethane foams, have been added to the Vibrathane group of raw materials supplied to the urethane industries. Others in the group include diisocyanates, casting resins, gums, chemical additives. — **Naugatuck Chemical Div., U. S. Rubber Co., New York.** 86C

Phenolic resin, BRR-7151, developed especially for hot-processed sand coating, is ideal where production speed is necessary. Resin's superior hot strength allows for faster cures and freedom from shell warping or cracking. Melt viscosities provide best flow for higher shell or core strength, and ideal shell weight pick-up in rapid cycles.—**Union Carbide Plastics Co., New York.** 86D

Defoamer, Eldefoam 4140, is recommended for foam control in paper and pulp operations. This thick liquid may be added directly to the system, or diluted with water to facilitate adding at desired concentrations. — **Foremost Food and Chemical Co., Oakland, Calif.** 86E

Isosorbide, a chemical intermediate, is available in development quantities for preparation of esters and ethers for specialty solvents, plasticizers, lubes, heat transfer media and hydraulic fluids. Derived from sorbitol, the compound (1,4:3,6-dianhydro-D-glucitol) is a polyol with two fused cis-oriented tetrahydrofuran rings. It's soluble in water, alcohol, glycerol and other polar solvents. Oxidation, dehydration, dehydrogenation, halogenation and reactions with amines and ammonia are fertile areas for investigation.—**Atlas Powder Co., Wilmington, Del.** 86F

Trimellitic anhydride—in developmental quantities — is now available in improved form and at lower price. Physical form has been changed from powder to flakes, to improve handling without changing ease of processing. The tribasic acid shows promise for surface coatings, plastics, adhesives. — **Amoco Chemicals Corp., Whiting, Ind.** 86G

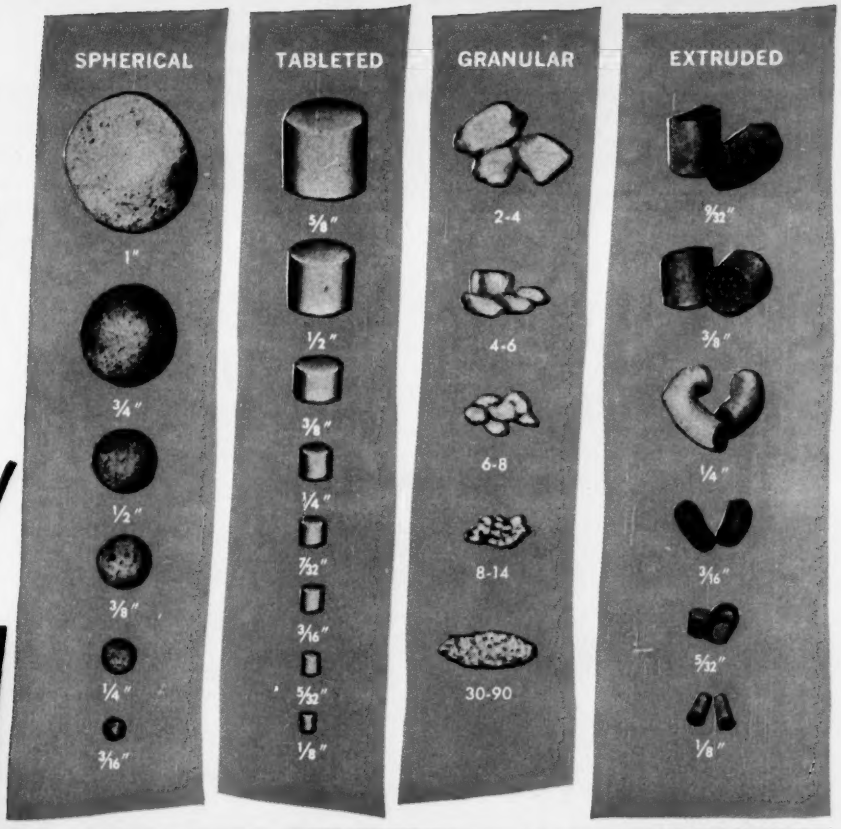
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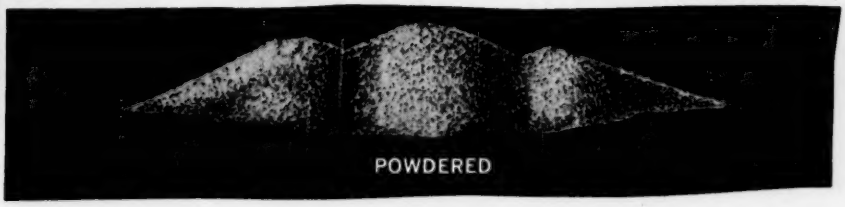
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Dehydrogenation	Isomerization
Hydrogenation	

Write for FREE Booklet, "HARSHAW CATALYSTS"



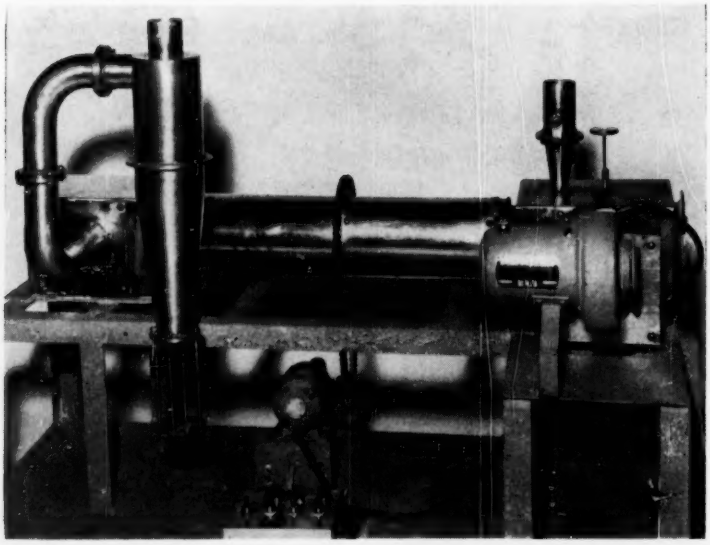
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CATALYTIC CHEMICALS SUPPLIED BY HARSHAW

Aluminum Nitrate		Cobalt Nitrate
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Metallic Soaps (Cobalt, Manganese)		
Nickel Carbonate	Nickel Formate	Nickel Nitrate
Nickel Sulfate	Sodium Methoxide	Zinc Nitrate

Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.

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READY to plug in, small dryer provides two speeds, seven air velocities.

Simulate Plant Drying at Bench

Stop guessing at what drying will do to new products. This bench-scale rotary gives you plant-scale preview.

Simple pan drying may take the moisture out of a sample of wet solids, but pan-dried product may not be anything like product from a continuous dryer. Engineers who want to see what continuously dried product is like can find out with a newly developed bench-scale rotary dryer which simulates big dryer operation.

Built by Bench Scale Equipment Co., Inc., (Benco) the dryer operates with either parallel or counterflow air movement. It can be converted to a louver-type unit, thus can simulate many commercial dryers on a bench scale. Various internal conveying flights may be used to alter the lifting and air-flow patterns within the rotating tube.

▶**How It's Used**—Bench-scale rotary drying can fill a need in three main areas: It can establish the applicability of rotary drying to a product, it can provide a means of preparing samples for product development work, and it can determine the effect of drying variables on product quality.

Benco offers the dryer as a complete package which only needs to be plugged into a 115-v. circuit to make it operable. The cylinder, of Type 304 stainless steel, is 2 ft. long and 4 in. in diameter.

A chain and sprocket arrangement turns the cylinder, which is covered with an inch of insulation. The slope of the cylinder can be increased in 1% steps up to 9% from horizontal to adjust the material hold-up time in the unit.

Drying air comes in through a blower. Downstream of the blower, elements in the ductwork heat the air to as high as 500 F. Seven different orifice plates may be placed in the duct to regulate the air velocity from 100 to 900 fpm. A bimetallic thermo-regulator controls air temperature.

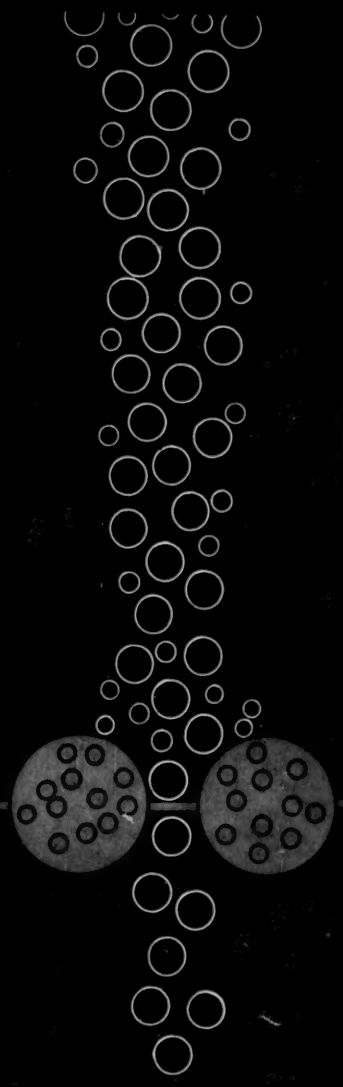
▶**Systems Interchangeable** — Dry product coming out of the dryer is blown by the air stream through a cyclone which is completely efficient on particles above 25 micron, according to the manufacturer. The blower-heater and dust collection systems are interchangeable, hence to change from parallel to countercurrent air flow, the operator merely switches them from one end of the unit to the other. These exchangeable sections also have heat-resistant glass windows so the operator can watch the material being dried.

Dryer can be fed either manually by a butterfly feeder or automatically with a motor-driven star feeder which is optional equipment. Also optional is the equipment necessary to convert the dryer to the louvre type.—**Bench Scale Equipment Co., Inc., Westfield, N. J. 88A**

Circuit Breaker

Stored energy closing and ironless blowout featured.

Switchgear and circuit breakers are now available with stored energy closing and ironless blowout construction for the first time in 4,160-v. rating. According to the manufacturer, breaker gives faster fault interruption and faster closing of



NOW—DRY NATURAL GAS MORE ECONOMICALLY

...WHEN YOU ADSORB WITH LINDE MOLECULAR SIEVES

This is only one of many applications which utilize the high capacity and selectivity of LINDE Molecular Sieves. In fact, Molecular Sieves not only outperform other adsorbents, but do other adsorption jobs never before accomplished. Whether in new installations or as replacement adsorbent in existing units, Molecular Sieves can help you minimize both investment and operating costs. More specifically, here's how they are used.

A major petrochemical company has reduced the CO_2 content of its ethylene from 3000 PPM to less than 1PPM. This high purity is achieved in a single-stage process, automatic and non-corrosive, which has proved to be more economical than the alternative four-stage process. Other petrochemical uses include drying of cracked gases, ethylene, hydrogen, liquid propylene, solvents and many other gases and liquids. **Natural gas producers** use Molecular Sieves for drying and sweetening of natural gas, for sweetening of liquid propane and butane, and for drying of adsorber oil. **Petroleum refiners** use them to gain efficiency in drying reformer hydrogen, liquid butane LPG and transformer oil, and for removal of impurities such as CO_2 and mercaptans. **Refrigeration manufacturers** use Molecular Sieves as a desiccant in super-drying refrigerants to eliminate freeze-up and corrosion.

For these and many other adsorbent applications, you can rely on patented LINDE Molecular Sieves to perform more effectively. They are the top quality material of their kind available today, always uniform, with high capacity, high strength, and high bulk density. They are available in regular and special grades to meet your specifications.

LINDE technical know-how—gained from years of laboratory and field work with adsorption problems—can help make Molecular Sieves work profitably for you. For further information, write: Dept. CE-065 Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. **In Canada:** Linde Company, Division of Union Carbide Canada Limited, Toronto 7, Canada.

SOME AREAS WHERE MOLECULAR SIEVES IMPROVE ADSORPTION

- Purification of ethylene
- Drying gases, liquids, solvents
- Drying, sweetening natural gas
- Sweetening liquid propane, butane
- Drying jet fuels
- Octane improvement
- As refrigerant desiccant
- Controlled atmosphere purification

LINDE COMPANY

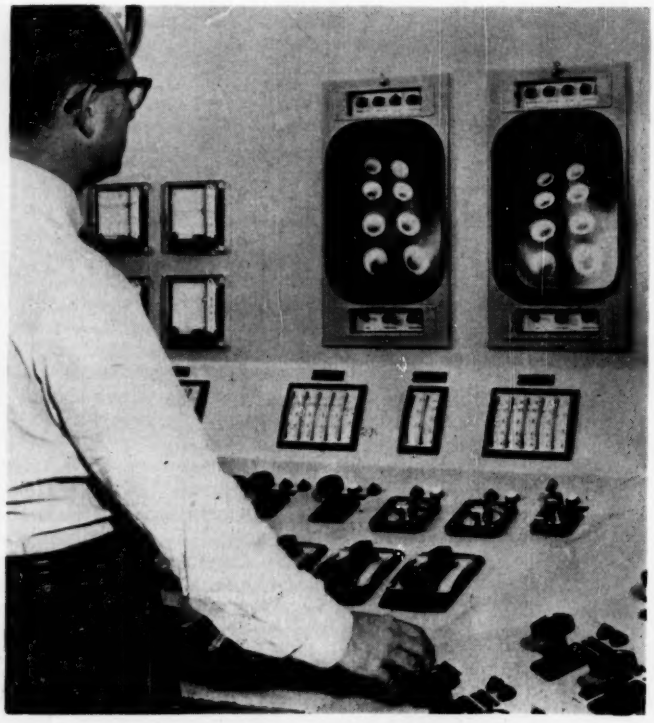
UNION CARBIDE

"Linde" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

contacts than comparable 4,160-v. units. It's smaller, too.

Motor-charged, spring-powered mechanism provides faster closing of contacts which improves contact life and makes the unit safer. Because action is positive, it does not depend on gravity, hence breaker will operate in any position.

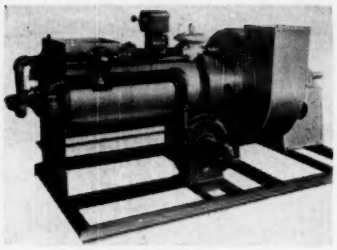
Ironless construction of blow-out chute makes fast arc breaking possible. Coils wound in both faces of the chute produce a high-flux magnetic field which pulls the arc up into the ceramic chute elements without the time lag that occurs when iron is used. New unit is easier to maintain and service.—**I-T-E Circuit Breaker Co., Philadelphia, Pa.** **88B**



Flying Saucer Display or Boiler Fire Watch?

That's neither a covey of flying saucers nor a brace of poached eggs that the operator above is watching in the TV monitor. He's keeping an eye on 16 different burners inside a giant boiler at the Scattergood Steam Plant in Los Angeles. Two cameras, mounted outside the boilers, peer through air-cooled windows at the burners and relay the picture to the control room. The operator can tell instantly if a burner goes out or develops other trouble.

Previous radiation-type detectors which could watch only one burner each, frequently interpreted hot furnace walls as burner flames and gave wrong information to the operator. Camera, called KIN TEL, has special filter to show red flame of oil and nonluminous flame of gas fuel.—Cohu Electronics, Kin Tel Div., San Diego. **90A**



Gas Air Heater

Heats and recirculates air at temperatures to 600 F.

Low-pressure-gas air heaters, which boost recirculating air temperature to 600 F., have a capacity range from 500,000 to 4,000,000 Btu./hr. Available in six sizes, the heater and its combustion system, safety controls, fan and motor are mounted on a single base.

The insulated heater body has a low pressure gas burner and combustion burner which fire into a refractory block centered in an alloy combustion tube. Hot gases are deflected downstream of the combustion tube into the recirculating air stream. Pull-through action from a recirculating fan causes a negative pressure in the heater.—**W. S. Rockwell Co., Fairfield, Conn.** **90B**

Plastic Ball Valve

Top-entry feature makes maintenance quick, easy.

Thermoplastic ball valve provides quick access to working parts. Operator unscrews valve bonnet, lifts out molded ball-and-stem and Teflon seating inserts. A nut on the valve bonnet adjusts seating pressure of the ball.

For temperatures to 150 F., valves are made of unplasticized polyvinyl chloride (UPVC). Chlorinated polyether (Penton) is used to make valves for hot corrosive service to 250 F. According to the manufacturer, both construction materials are non-sparking, non-toxic, non-flammable and have high tensile strength.

Valve ports are full-opening for nominal pipe sizes of ½ to

To produce inerts in any quantity, for any job . . .

KEMP INERT GAS GENERATORS

—are best 3 ways!

1. Easy to start, set and forget

With Kemp's unique carburetor and external test burner, you check the pre-mixed gas-air ratio *before* it enters the combustion chamber . . . start fast with the electric ignition. Then set the vernial dial and forget it! The carburetor maintains the exact air-gas ratio—no rechecking needed.

2. Precise fuel control

You'll find the Kemp Carburetor automatically pre-mixes and keeps gas and air at the exact mixture you wish. And no matter what the total demand or pressure changes in your supply line, this precise air-gas ratio is maintained at all times.

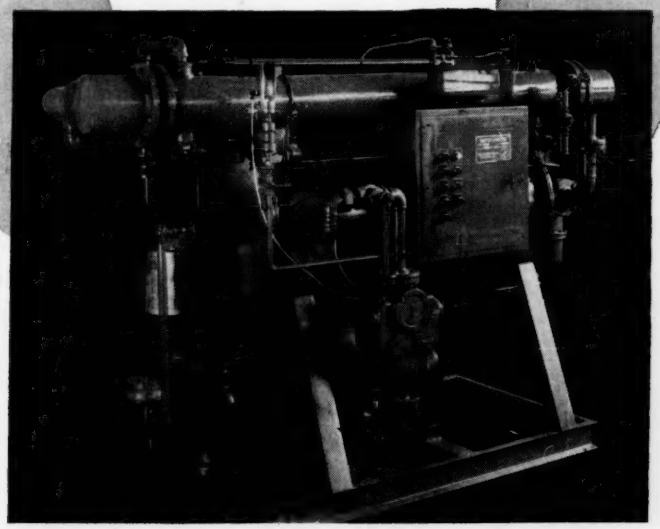
3. Automatic safety

Kemp safety controls eliminate the danger of flame-out. An electronic flame-failure control instantly, automatically cuts off the carburetor's gas supply. This control operates under all conditions . . . unaffected by moisture or combustion chamber pressure.

If you need inert gases for blanketing, purging and protective uses, write for Bulletin L-10 . . . or call in your Kemp Man listed in the yellow pages or the Chemical Engineering Catalog.

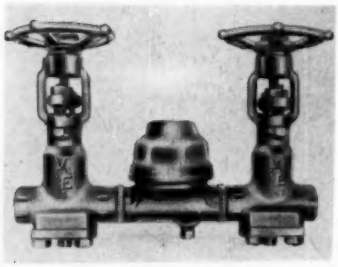
It always pays to come to

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3-in. Valves are available in threaded or socket type—**Tube Turns Plastics, Inc., Louisville, Ky.** 90C



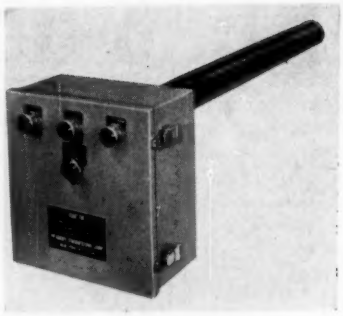
Valved Steam Trap

Valve-trap-valve construction speeds installation.

Only two connections are needed to make a complete steam condensate installation with TSV trap and valve units. A forged-steel steam trap with integral strainer, check valve, and air vent is welded to either one or two forged-steel gate valves.

Steam trap is bimetallic element type with stellite faced seat. In normally open position, trap vents air and condensate freely, closes on steam. Return line pressure exceeding inlet steam pressure will close valve to prevent back flow. Strainer and element can be replaced by unscrewing top and two screws without removing the trap from line.

Shut-off valves are patented bonnetless design with screw—in stainless-steel seats. Seats, wedge and stem can be replaced with valve in line. TSV unit comes in ⅜ to 1 in. sizes for service up to 250 psi.—**Velan Steam Specialties, Inc., Plattsburgh, N. Y.** 92A

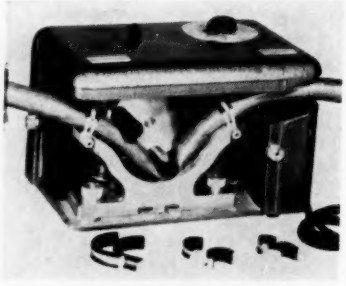


Gas-Electric Ignitor

Integral flame-proving makes operation safe.

For boilers, flares and fuel vents, new FP gas-electric ignitor touches off flame, then either proves that flame continues or shuts off gas flow. Unit, which uses transformer and spark for ignition, uses flame as a conductor in the proving circuit. If proving circuit is not established within 15 sec., unit automatically closes main gas valve.

Long life is claimed for the unit because transformer and spark cut out when flame is established, thus reducing electrode wear and maintenance. FP ignitor handles up to 5 million Btu./hr. capacity at gas pressures from 1 to 15 psi. Unit can be removed while furnace is under pressure.—**Peabody Engineering Corp., New York 16, N. Y.** 92B



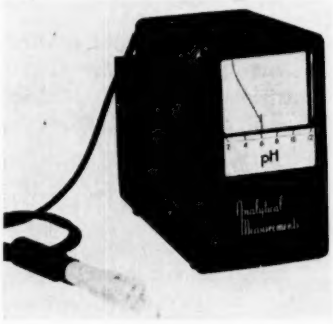
General-Purpose Pump

Flexible hose is pulsed to move solids, liquids.

Solids, liquids and gases are moved by positive displacement in new pump which has no glands or return valves. Revolving arms compress flexible tube, squeeze contents through tube from cc./min. to 500 gal./hr.

Pumped material passes only through hose, hence never touches any other working parts of the pump. Motor is steplessly variable to 200 rpm., and since delivery per revolution is virtually constant, pump can meter at any desired rate within its range.

Positive displacement nature of the pump makes it self-priming. It can act as a vacuum pump or as an oil-free compressor, can be reversed to pump in the opposite direction by flipping a switch. All parts are self-lubricating.—**Schueler & Co., New York, N. Y.** 92C



Recording pH Meter

Makes continuous record of system pH changes.

A combined pH meter and strip chart recorder is now available to continuously monitor and record pH levels in process streams. Instrument uses an electronically modulated amplifier which has standard radio tubes and compensates for line voltage fluctuations.

Printed at 1 in./hr., chart will record for a month. Gear change gives faster movement if needed. Chart surface contains pressure-activated coating on which a stylus makes a permanent impression, hence no pen or ink reservoir is used. Instrument serves as an indicating pH

EQUIPMENT NEWS
Continues on . . . **Page 166**

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about any item in this department, circle its code number on the

Reader Service

postcard (p. 183)

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U.S.I. CHEMICAL NEWS

June ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1960

Sodium Dispersions Now Sold by Several Companies

Many types of sodium dispersions are now being sold commercially by several companies. These firms already prepare sodium dispersions for their own chemical manufacturing operations, and so are familiar with the techniques involved.

Sodium dispersions, of course, have been recommended for many years for their high surface area and, consequently, high activity in reactions such as Claisen condensations, Wurtz type reactions, sodium alcoholate preparations, metalations, preparations of sodium alkyls and aryls, polymerizations and many others. Until dispersions were offered for sale commercially, however, they had to be made by the user in situ as required. Some special equipment and operator training are needed for dispersion preparation, and it is believed that these needs may have discouraged use of dispersions on a broader scale in the past, especially where small quantities were involved. The availability of commercial dispersions now is expected to increase their use in chemical reactions.

One supplier offers two standard types of sodium dispersions. The first is a solid composed of 50% sodium and 50% paraf-

MORE

Chemistry Booklet for The Elementary School Teacher Supplied by MCA

"Matter, Energy and Change", a booklet containing a course of study in chemistry for elementary school children, is being offered to school supervisors and teachers at below-cost prices, as an educational service of the Manufacturing Chemists' Association.

The 50-page booklet attempts to supply up-to-date knowledge to the science educator in the rapidly growing and changing field of chemistry. It presents this knowledge by outlining a series of explorations for the children. For youngsters through third grade, there are explorations into materials, changes, water, air and plants. For older children through sixth grade, there are explorations into the nature of matter, chemical reactions, electricity and matter, chemical tests, crystals and photography.

This booklet represents a part of MCA's extensive aid-to-education activities, designed to stimulate the understanding of chemistry at many levels.

Up-To-Date Catalog On Ethyl Alcohol Now Available from U.S.I.

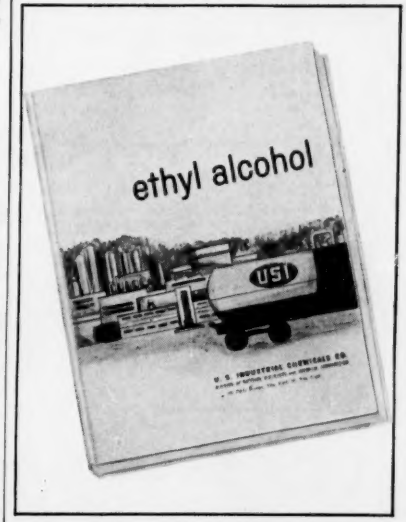
132-Page Book Contains Complete Information on Pure Ethyl Alcohol and Denatured Alcohol Formulations

U.S.I.'s new Ethyl Alcohol catalog has just been published. Type style and format of the up-to-date edition have been carefully selected for easy reading. Comprehensive and thoroughly documented, this illustrated catalog covers:

(1) Pure ethyl alcohol—properties, specifications, shipping data.
(2) Specially denatured alcohol formulas—authorized denaturants, compositions and uses; properties; shipping data.
(3) Completely denatured alcohol formulas—authorized compositions, specifications, properties, shipping data.
(4) Proprietary solvents: SOLOX®, FILMEX® and ANSOLS®—authorized compositions, uses, specifications, properties, shipping data.

In addition, there is a section on the general properties of ethyl alcohol, including graphs, tables and bibliography, and a section on methods of testing. Appendices include standards, tests and assays of the ACS, NF and USP; container descriptions; gauging techniques for drums, tanktrucks and tankcars; and methods of handling. A glossary of terms completes the volume. Sections are tabbed for quick

MORE



U.S.I.'s new Ethyl Alcohol catalog.

Complete Property Data On Pure Nitric Acid Published Recently

The most current and accurate information available on the physicochemical properties of pure nitric acid has been collected, evaluated and presented in a 23-page report in the April issue of *Chemical Reviews*, a bimonthly publication of the American Chemical Society. The report includes discussions and data on: various methods of preparing nitric acid; all physical properties; self-ionization; thermodynamic properties; stability. It concludes with a list of the 216 references the authors used in compiling their data.

This collected information should be of particular value to laboratory, design and theoretical workers. It should also be useful to those engaged in the production, handling and storage of highly concentrated solutions of nitric acid for rocket fuel applications, as well as industrial producers and users of the material in any concentration.

Polyethylene Pipe and Fittings Joined by Fast Heat Sealing Technique

A patented process has been reported for joining polyethlene pipe and fittings, using nothing but heat and a special tool of simple design. In the process, called "Polyfusion", the outside of the pipe and inside of the fitting are heated on the Polyfusion tool and joined together to form one homogeneous piece. Any conventional heat source—flame or electric—can be used. No glue, cement, solvent or other material is needed. It is reported that only 10 to 20 seconds are required to fuse a joint.

CONTINUED

Alcohol Catalog

reference and each section has a table of contents.

A 20-page Government Regulations supplement is contained in a pocket inside the back cover, so that it can be easily replaced when changes are made in federal regulations. You can obtain a copy by making a request on your company's letterhead.

CONTINUED

Sodium Dispersions

fin or naphthalene binder, shaped into one-pound bricks. The other is a liquid made up of 50% sodium and 50% mineral oil. The company also offers other liquid dispersions as required.

A second company is marketing a crushed solids dispersion containing 50% sodium and 50% napthalene, as well as a dispersion gel consisting of 50% sodium and 2% aluminum stearate in mineral oil.

Still another company supplies four standard types of dispersions: 30% sodium and 50% sodium in xylene, and 30% sodium and 50% sodium in special naphtha cuts. They will also supply mineral oil dispersions on request.

New Microporous Films of Polyethylene Repel Water But Transmit Vapors

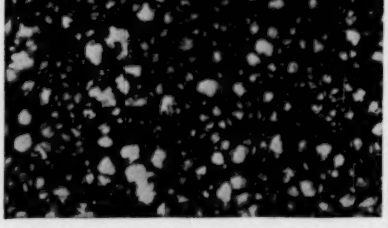
It is reported that a technique has been developed for producing extremely fine, uniform, interconnecting pores in polyethylene films. This makes the plastic vapor-transmitting and water-repellent at the same time. Films so prepared are being investigated for use in clothing, filters, medical equipment, solar water purification apparatus, electrodialysis equipment and other specialty applications.

As normally produced, these polyethylene films are said to have a porosity of about 80%, with all pores in the 8-12 micron range. Because of this extremely high void volume and the interconnecting structure, gases and vapors can diffuse through the films with very little interference. But because the polyethylene itself is hydrophobic, surface tension prevents water or aqueous liquids from penetrating the extremely fine pores. In this way, the material transmits water vapor but is completely water-repellent.

The pore structure is reportedly achieved through the use of starch as a leachable material. Polyethylene resin and starch are mixed, and the mixture is converted to sheet by any of the conventional methods such as calendering or extrusion. At this stage the starch in the sheet is encapsulated in very thin walls of polyethylene.

Next the sheet is immersed in boiling water to wet and expand the starch. Cornstarch, for example, will swell to well over twice its original volume. The expansion ruptures the plastic walls encapsulating the starch and results in the interconnecting pore structure. Starch is then removed by sulfuric acid hydrolysis and leaching.

It is claimed that by selecting starches of different particle sizes, altering the basic process, and varying the plastic formulation, a great variety of microporous plastic materials can be made having a tremendous range of properties.



Photomicrograph (200 magnification) shows typical pore structure of microporous polyethylene film. (Courtesy ESB—Reeves Corp.)

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Polyethylene in powder form, a new development for coating metals, textiles, paper, glass, etc., for molding and other purposes, is described in technical data bulletin now available. Said to open new uses for polyethylene. **No. 1600**

Etching solution now on market makes fluorocarbon polymers bondable to other materials. Material is activated form of sodium in solvent. Extracts fluorine from surface, leaves carbonaceous film compatible with adhesives. **No. 1601**

Health factors in safe handling of chemicals is subject of first in series of pamphlets on safety, to be sold at nominal cost by MCA. Pamphlet is designed to acquaint non-chemists in chemical plants with toxicological terms, toxicity mechanisms, first aid principles. **No. 1602**

New portable conductivity and temperature measuring Solu Bridge for measuring tidal movements, salinity, industrial pollution, etc. is now on market. Covers, in 3 ranges, 40-400,000 micromhos/CM specific conductance. **No. 1603**

Portable water softener recently developed works by electric membrane process, is claimed 500 times more efficient than comparable electrical devices. Said to soften 2 gallons of hard water per hour on 10 watts of electricity. **No. 1604**

Coagulant aids, described in new bulletin, are used in municipal and industrial water systems, waste waters, cold and hot process softening, oil field waterflooding, brine clarification, color removal, high solids-liquid separation. **No. 1605**

New miniature infrared photoelectric scanner (proximity sensor) contains both light source and pick-up head in one small housing. Simplifies installation and operation in many counting and control applications. **No. 1606**

New dispersants and inhibitors have been developed to prevent formation of sludge in fuel oils. Dispersants are dialkyl dimethyl ammonium chlorides. Series of 14 fatty amine derivatives comprise the group of inhibitors. **No. 1607**

Chemical fume scrubbers of fiberglass-reinforced polyester resin now being designed. Units up to 47 feet high by 10 feet in diameter have been made. Plastic chosen for strength, lightness, chemical and flame resistance. **No. 1608**

Story of chemistry is subject of new book now being sold. Part I includes Egyptian, Greek, Arabic chemical knowledge and Western work to discovery of oxygen. Part II carries through latest discoveries in nuclear chemistry. **No. 1609**

PRODUCTS OF U.S.I.

Ethyl Alcohol: Pure and all denatured formulas; Anhydrous and Regular Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL®M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

Pharmaceutical Products: DL-Methonine, N-Acetyl-DL-Methonine, Urethan USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions, Phosphatic Fertilizer Solution, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide.

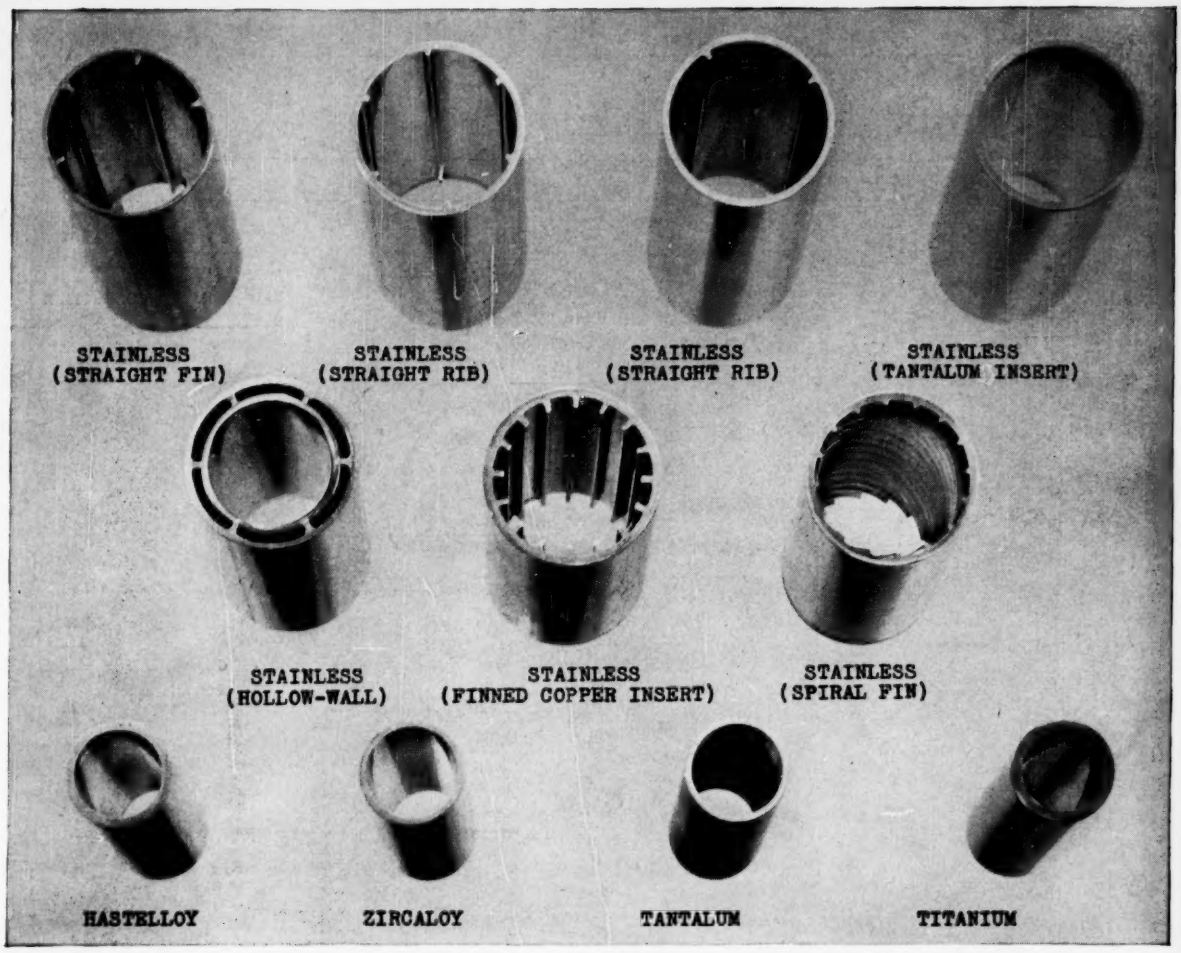
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MICROTHENE ... Finely Divided Polyethylene Resin.

Animal Feed Products: DL-Methionine, MOREA® Premix (to authorized mixer-distributors).

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ALL OF THESE TUBES WERE PRODUCED by a remarkable new process called FLO-ROL

Tubes like these have never been economically available before. The entirely new process, known as FLO-ROL, will produce a wide variety of internal configurations, in high cost alloys, stainless steel, and other hard-to-work metals, plus many bi-metal and tri-metal combinations. Wall tolerances for FLO-ROL tubing can be held to ±.0005" and diameters to ±.002" depending on sizes.

- *Internally Finned Tubes* offer increased surface for more rapid heat transfer.
- *Bi-Metal Tubes*—stainless steel tubes with tantalum, zirconium, or other expensive material offer exceptional corrosion-resistant qualities without the prohibitive cost.
- *Hollow Wall Tubes* or barrier tubes are available in several designs for nuclear work or other special applications where a chambered tube is essential or desirable.
- *Thin Wall Tubes* for pneumatic lines are available with .015" wall or lighter.

FLO-ROL precision tubular products can be furnished from ½" to 2½" O.D. and, in some instances, in lengths up to 75'. For complete information contact your nearest Damascus representative or write direct. For prompt service send prints and specifications—we will be happy to work with you.

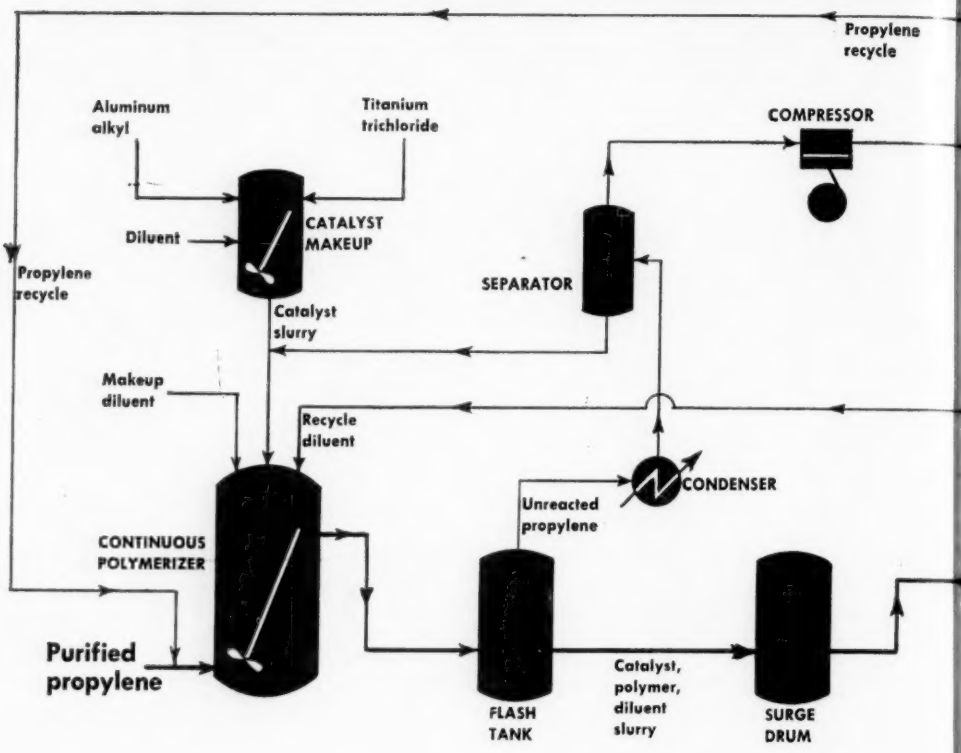


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DAMASCUS TUBE COMPANY

STAINLESS STEEL TUBING AND PIPE

GREENVILLE, PENNSYLVANIA



Polypropylene by the Ziegler Process

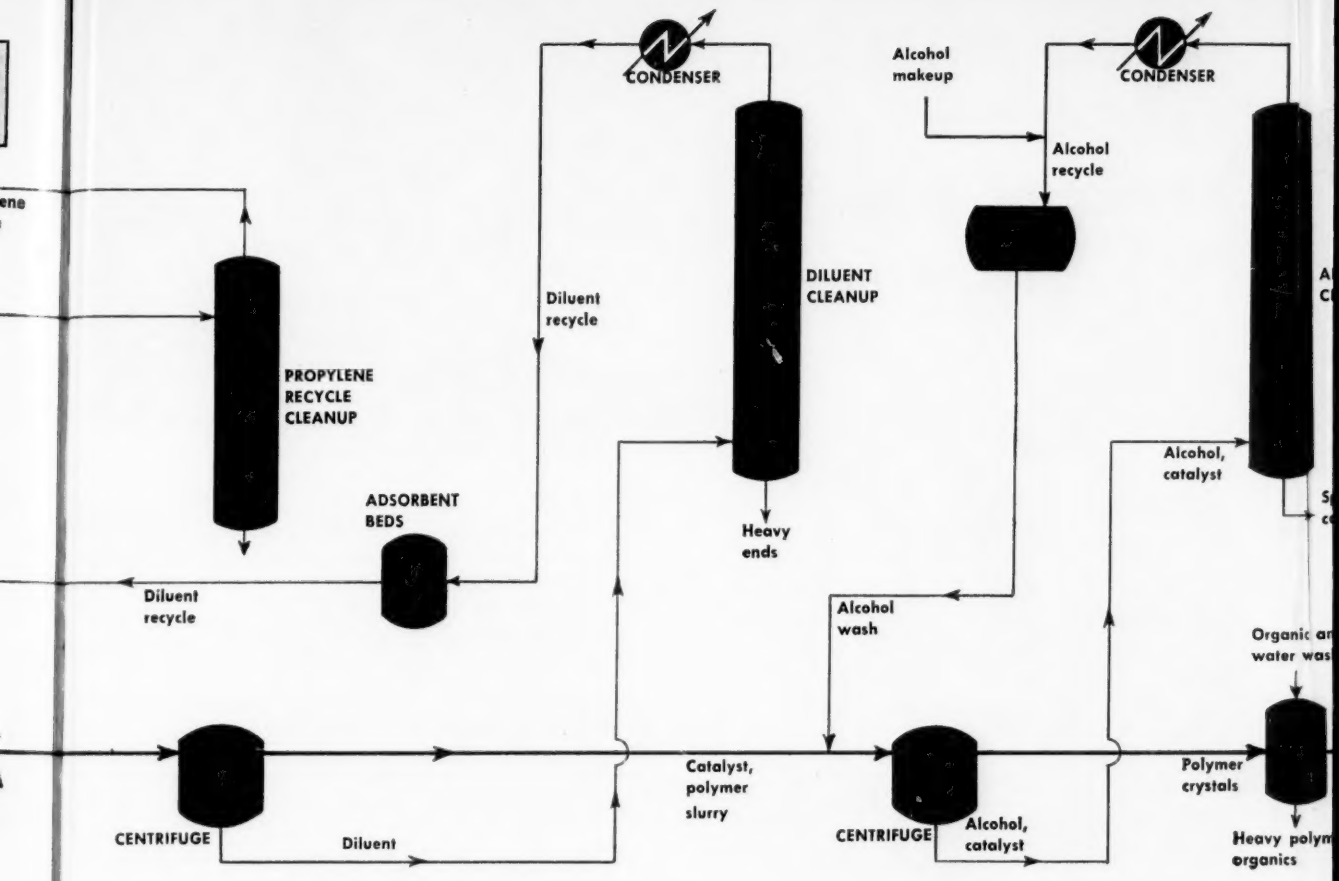
Improved catalyst system and streamlined flowsheet characterize Humble's version of the Ziegler process now operating at its Baytown, Tex., refinery.

With the opening of its 40-million-lb./yr. polypropylene plant near Houston, Tex., Humble Oil & Refining has given technical people in this country their first—although not too detailed—look at the commercial workings of Ziegler chemistry. Highlights of the Humble plant: (1) a versatile, patent-applied-for catalyst which is claimed to have ten times the activity of original Ziegler catalysts; (2) a streamlined process which reportedly simplifies the task of catalyst removal.

Other polypropylene plants now on stream using Ziegler chemistry: Hercules Powder at Parlin, N. J.; AviSun at Port Reading, N. J. Dow Chemical, Texas Eastman and Montecatini's Novamont subsidiary have polypropylene plants on the way. Total polypropylene production in the U. S. is expected to hit 50-60 million lb. this year and be in the several-hundred-million-lb./yr. category in a few years.

In anticipation of rapid market development,

Unfold Flowsheet



s Looms as Potential Big-Volume Plastic

Humble's new plant can be expanded to 100 million lb./yr. in about six months. Unofficial estimates place the capital cost of the new Humble plant at around $10 million. Only figure that Humble gives out is the total cost of the polypropylene project: $30 million. Of this cost, $15 million went into research and development.

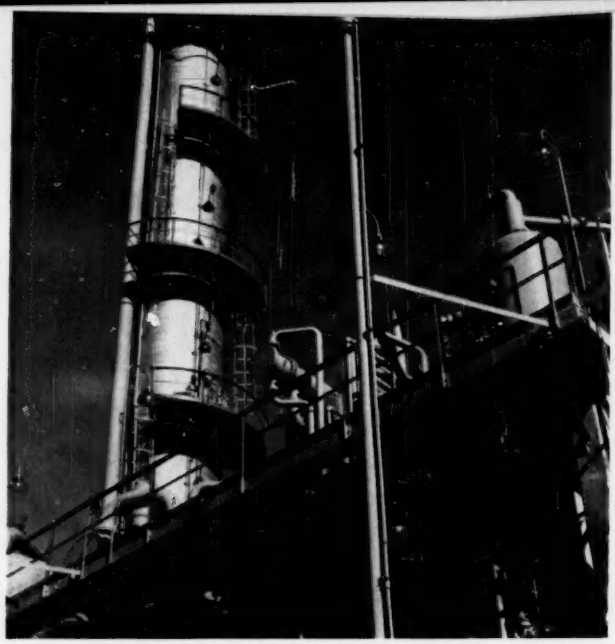
▶**Patent Outlook: Cloudy** — Humble's new plant operates under a Ziegler license as do all other polypropylene producers. But any engineering similarities between any of the commercial Ziegler processes would be entirely coincidental. As one engineer puts it: "There is no such thing as the Ziegler process. The Ziegler license is only a hunting permit. You start with that and develop your own process."

Consequently, every company has patent applications in on its own process features and the Patent Office will evidently be deliberating many more months before claim and counter-claim can be sorted out. In the meantime, companies are forging ahead with their own plans, confident that when the situation is clarified any conflict can be settled by cross licensing.

▶**Secret Is in the Catalyst**—Humble's new high-activity catalyst, developed by Esso Research & Engineering, is the key to the whole process. Since the catalyst is used only once, the higher the activity, the less catalyst is needed per pound of product—resulting in lower production costs and higher throughputs.

Too, the versatile catalyst can polymerize C_2 through C_9 olefins. Esso admits it seriously considered making low-pressure polyethylene before

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TOWER, about 100 ft. high and 8 ft. dia., fractionates diluent before it recycles. Polymer separation unit is in foreground.



EXTRUDERS force melted polypropylene powder i like strands. Hardened strings are then choppe

ding on polypropylene. And there is good on to believe polyethylene production is in the g, especially since the new Baytown unit is iguously called the "polyolefin plant." Esso admits it is seriously looking at polybutylene higher polymeric materials. It believes its ver- catalyst may give it a jump over competitors ringing some of these newer polymers to com- cial fruition.

ice Versus Process—Humble's Enjay division be selling polypropylene for about 42¢/lb., pared with about 35¢/lb. for low-pressure ethylene.

But propylene is a slightly cheaper raw mate- than ethylene and the processing required to uce the two polymers is almost identical so both could probably be priced similarly mpetition demanded. But producers are rely- on polypropylene's improved temperature re- nce and better physical properties to avoid ut price competition with polyethylene, are ng primarily at new markets such as textile s and a clear film to compete with cellophane.

▶ **Process Outline**—There are four major sections in the Humble plant: catalyst preparation, polymerization, polymer separation, polymer finishing. Humble is vague about details of the first three sections of the plant and the flowsheet above does not necessarily represent the exact details of Humble's process; it is representative of Ziegler polyolefin production in general.

To form the catalyst, Humble charges titanium trichloride and aluminum alkyls to the preparation unit. Catalyst is formed as platelets and ends up as a purplish-looking slurry which feeds to the polymerizers.

There are two parallel trains of equipment in the reaction and separation section. Each polymerizer is about 40 ft. tall and 8 ft. dia. In these vessels, catalyst slurry contacts the propylene which is dissolved in an unidentified hydrocarbon diluent. (For preparation of polymerization-grade propylene, see *Chem. Eng.*, May 30, 1960, pp. 78-81.) Residence time in reactor is believed to be about 10 sec.; temperature is controlled at about 150-160 F. and pressure at about 60 psig. Molecular

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Polymeriza than that of et three steroisom one. Through c mercial polypro these three for and sterobloc sible a wide ran

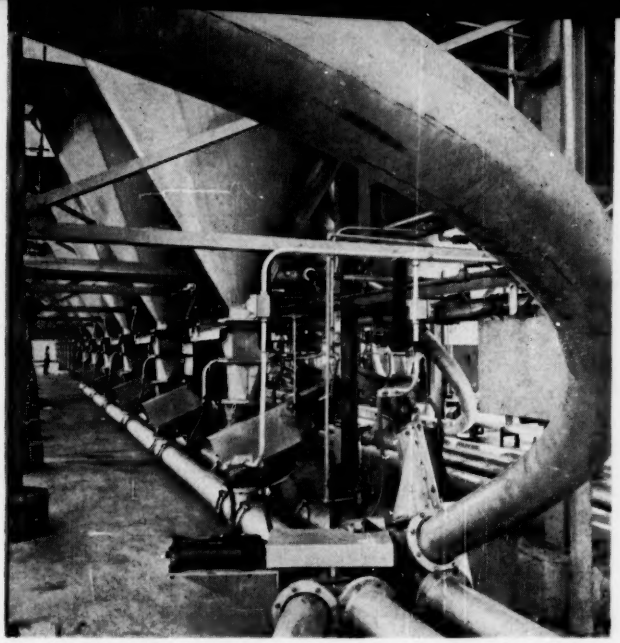
▶ **Problem: Ren** the polymerizer and diluent at a ping tanks abou unreacted propy the reactors.

Hardest step and recovering any catalyst is seriously effect is the most crit most reluctant

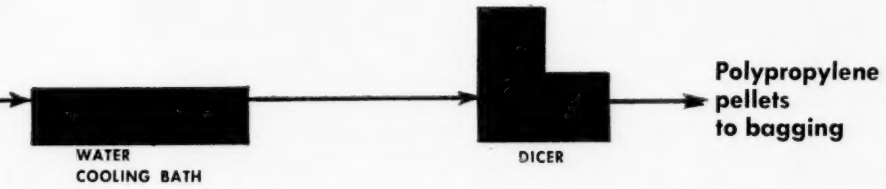
About all th



ne powder into spaghetti-
ien chopped into pellets.



STORAGE BINS provide holdup for finished polypropylene pellets. From here the product flows to final bagging station.



t of the polymer is controlled by the Al:Ti in the catalyst and by the temperature.

Polymerization of propylene is more complex that of ethylene because of polypropylene's steroisomers compared with polyethylene's Through control of reaction conditions, com-al polypropylene is actually a mixture of three forms; the ratio of atactic, isotactic teroblock isomers in the mixture makes pos-a wide range of polymer properties.

blem: Remove the Catalyst—Stream leaving olymerizers is a slurry of polymer, catalyst diluent at about 20% solids. It flows to strip-anks about 20 ft. high and 10 ft. dia. where cted propylene flashes out and is recycled to eactors.

rdest step comes next: removing the catalyst ecovering solid polymer from the slurry. If atalyst is left in the finished product, it can sly effect polymer properties. And since this most critical step, it is the one Humble is reluctant to talk about.

bout all that is known for sure is that Humble uses an unidentified alcohol to dissolve the catalyst and separate it from the polymer. Polymer crystals can then be centifuged or filtered to separate it from the liquid phase and can be washed with hydrocarbons such as heptane and ether to remove tacky polymer followed by a water wash. Polymer undergoes at least five washings in this stage.

Both the hydrocarbon diluent and the catalyst-removing alcohol are recovered and are recycled after purification by distillation.

▶ **Ready for the Bag**—From final washing stage, wet polymer powder flows to two steam-heated double-shell dryers operating in parallel. Each dryer is about 100 ft. long and 10 ft. dia.

From the dryers, dried polymer crystals are conveyed to extruders where they are melted and squeezed into spaghetti-like strands. These strands are then cooled in a water bath and fed to dicing machines where they are chopped into small pellets. From dicers, pellets flow to storage bins and then to bagging stations where pellets are put up in 50-lb. bags for shipping.

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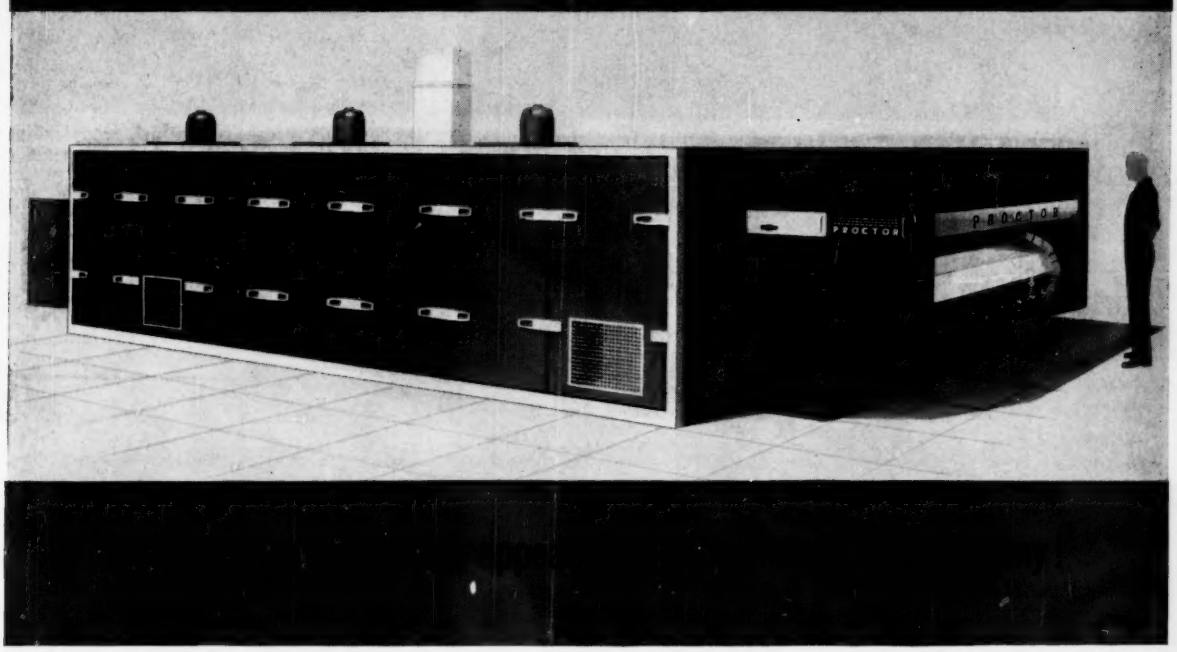
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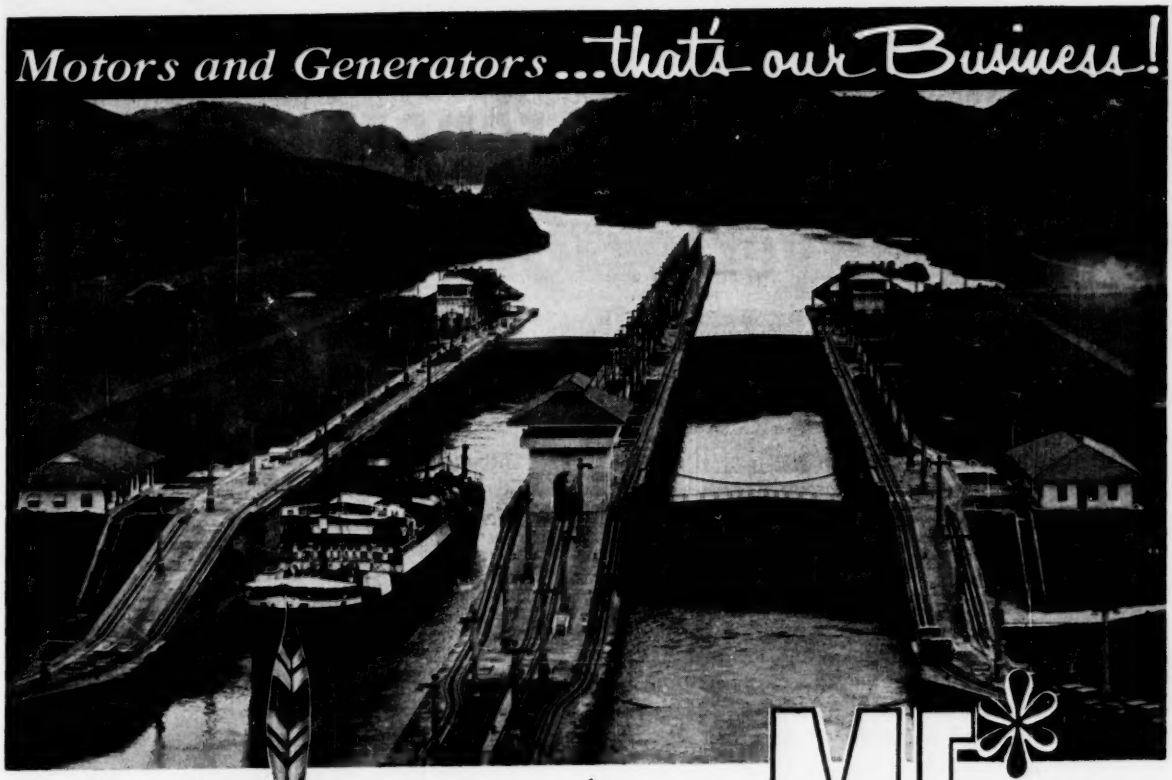
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A Pennsylvania metals plant has found Ryertex-Omicron PVC sheets perfect for the exhaust system above a series of pickling tanks. After more than two years this company reports "complete satisfaction"—and actually Ryerson's PVC will *never* corrode . . . *never* need replacement. In addition, good fabricating qualities and light weight made construction and installation of the extensive system much easier.

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Lowers costs three ways

A Midwest vinegar company is switching to lines of Ryertex-Omicron PVC at all its plants on the basis of an installation at its newest plant, built a little more than a year ago. Ryerson's PVC reduced by two-thirds the initial cost of piping at this plant. It has given, and will continue to give, absolute resistance to the acid solutions, and only one man is needed to change the entire system of lines when switching product runs.

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Chemical Engineering
JUNE 27, 1960



Recognizing and measuring radioactivity in radiochemical operations: big factors in . . .

Minimizing Radiation Hazards

L. J. CHERUBIN, Knolls Atomic Power Lab., General Electric Co., Schenectady, N. Y.

Chemical engineers now are actively engaged in the atom-energy field in many technical, operational and administrative positions.

Regardless of whether they are involved in operations of a plutonium-production plant or atomic reactor, or designing radiochemical processes, chemical engineers quickly come up against a little-understood problem: radioactivity as a health hazard.

No nuclear facility can operate for long without proper safeguards against radiation exposure. Yet the specific hazards involved and how they may be minimized are little understood except by the "experts" in the field. To dispel some of the mystery surrounding radiation effects, we are going to discuss some aspects of radiation and human health, and industrial methods of measuring and monitoring. We will limit this article to situations you might encounter when working in a plant handling or processing nuclear materials (liquid or solid).

We Need More Data

The natural occurrence of radioactive materials and radiation on earth has been recognized by scientists for many years, and the basic health problems associated with radiation have been appreciated.[1] Because of small quantities and limited use, the radiation hazard has been a minor problem as reflected in the slow evolution of radiation protection standards nationally[2] and internationally.[3]

Today, however, the situation is changing. Nuclear power is an accepted fact and the production and handling of nuclear fuel and other radioactive items a major industrial item.

Radiation awareness is a must, expecially in the processing industries where radioactive materials are used, produced or handled. The situation is complicated

by a lack of complete information or an abundance of the wrong kind of information. No one, not even the experts, have all the answers about radiation. The best knowledge we have today: actual experience accumulated within the past several years projected against and interpreted with radiation theory derived from human and animal experiments.

A major problem in radiation protection work is that human senses are not acute enough to detect radiation during exposure to it. As a result, varied and complicated instrumentation is needed. Also, everyone receives a certain amount of natural radiation every day from natural causes, such as cosmic rays, that have always been within the human experience. It is the amount of radiation received in excess of this daily amount that is significant in determining exposure limits.[4]

What Are the Hazards?

Radiation, from radioactive materials or from radiation-producing machines, can cause serious effects such as cancers, cataracts, sterility, severe skin burns, genetic malformations in progeny, and life-span reduction.[4] Other less serious symptoms of exposure are epilation, nausea, diarrhea, erythema, and fatigue. Acute radiation exposure to a significant portion of the body can result in death in a matter of days.[5]

One important characteristic of radiation injury is that latent effects predominate from chronic overexposure.[1] Tumors, cancers, and cataracts may take from a few to several years to appear.[1] A redeeming feature is that cell injury from radiation is in some degree reparable with time in those situations where threshold dosages are necessary before any clinical evidence of injury shows up. Some authorities postulate that there is no threshold dosage for genetic effects, leukemia incidence, and perhaps life-span reduction. Unfortunately, experimental difficulties to date have prevented a resolution of this question.[6, 7]

As for relative sensitivity of human organs to radiation, the blood-forming organs, gonads and eyes (lens) are the most sensitive; and thyroid and skin are among the less sensitive. Allowance is given for this relative insensitivity in the maximum permissible limits of radiation exposure established by the National Committee on Radiation Protection and Measurement.[4]



CALIBRATING meters—Fig. 1

Radiation Takes Many Forms

Radiation, from whatever source, can be defined as the electromagnetic spectrum (X-rays, gamma rays, and cosmic rays) above the ultra-violet wave-length range and as nuclear particulate (alpha particles, beta particles and neutrons).

X-rays are produced when high-speed electrons or beta rays (electrons) are decelerated by collision with matter. Gamma rays are similar to X-rays, but are the result of nuclear-energy state changes in unstable (radioactive) atoms. They are generally accompanied with alpha- or beta-particle emission from the nucleus of a radioactive atom. Cosmic rays are believed to be charged high-energy atoms which produce a variety of other secondary high-energy particles such as positrons, mesons, etc., in addition to gamma rays, on collision with matter.[8] Alpha particles are, of course, positively charged helium atoms, while beta particles are negatively charged electrons.

Common natural elements which emit alpha particles are uranium, thorium, actinium, radon, thoron, radium, and polonium.[5] Many of the daughter elements produced in the decay chain of uranium, thorium, and actinium emit beta particles (mesothorium, Pb-210, Pb-214, Bi-210). Other beta emitting radioelements are K-40, C-14, and the fission products. Among these are such well-known radioelements as: Sr-89, Sr-90, Cs-134, I-131, Ce-144, Zr-95, etc. Other common radioelements produced through activation of pertinent stable elements by absorption of neutrons are: tritium (H^3), Co-60, P-32, Mn-56, Na-24, Fe-59, etc. In general, gamma radiation is associated with beta emission.

Exposure: Three Ways

The human body may be exposed to radiation in three ways:

- Radiation impinging from an external source (X-ray machine, accelerator, reactor, encapsulated source containing a radioelement, surface contamination of the environment or surface contamination of the individual).
- Internal intake and deposition of a radioelement in organs (inhalation of contaminated air, ingestion of contaminated food and water, absorption through broken and/or unbroken skin).
- A combination of both external and internal irradiation from many combinations of situations.

Sources of airborne contamination are usually radiochemical operations, radiometallurgical operations, spills of radiochemicals, ventilation and venting systems serving process areas and facilities, maintenance in radioactive material areas, and decontamination of facilities, equipment and tools.

Degree of internal exposure depends upon the amount, chemical and physical properties and metabolism of the radioelements in the body. Particle size of the aerosol, solubility, decay rate, elimination rate of the element, and the quality of radiation and its relative biological efficiency—all these parameters are important in assessing

Maximum Permissible Radionuclide Concentrations—Table I

Radionuclide and Type of Decay		Organ	Maximum Permissible Burden in Total Body, Microcurie	Maximum Permissible Concentrations for 40 Hr. Wk. (MPC)w* Microcurie/CC.	(MPC)a* Microcurie/CC.	for 168 Hr. Wk. (MPC)w* Microcurie/CC.	(MPC)a* Microcurie/CC.
$_{1}H^{3}$ ($H_2{}^{3}O$) (β^-)	(Sol.)	Total body	2×10^{3}	0.2	2×10^{-5}	0.05	7×10^{-8}
	(Immersion)	Skin	.....	.....	2×10^{-3}	.....	4×10^{-4}
$_{11}Na^{24}$	(Sol.)	Total body	7	0.01	2×10^{-6}	4×10^{-3}	6×10^{-7}
(β^-, γ)	(Insol.)	Lung	.....	.....	8×10^{-7}	.....	3×10^{-7}
$_{15}P^{32}$(β^-)	(Sol.)	Bone	6	5×10^{-4}	7×10^{-8}	2×10^{-4}	2×10^{-8}
	(Insol.)	Lung	.....	.....	8×10^{-8}	.....	3×10^{-8}
$_{18}A^{41}$	(Immersion)	Total body	.....	.....	2×10^{-6}	.....	4×10^{-7}
(β^-,γ)							
$_{36}Kr^{85}$ (β^-)	(Immersion)	Total body	.....	.....	10^{-5}	.....	3×10^{-6}
$_{38}Sr^{89}$(β^-)	(Sol.)	Bone	4	3×10^{-4}	3×10^{-8}	10^{-4}	10^{-8}
	(Insol.)	Lung	.....	.....	4×10^{-8}	.....	10^{-8}
$_{38}Sr^{90}$(β^-)	(Sol.)	Bone	2	4×10^{-6}	3×10^{-10}	10^{-6}	10^{-10}
	(Insol.)	Lung	.....	.....	5×10^{-9}	.....	2×10^{-9}
$_{53}I^{131}$	(Sol.)	Thyroid	0.7	6×10^{-5}	9×10^{-9}	2×10^{-5}	3×10^{-9}
(β^-,γ,e^-)	(Insol.)	Lung	.....	.....	3×10^{-7}	.....	10^{-7}
$_{88}Ra^{224}$	(Sol.)	Bone	0.06	7×10^{-6}	5×10^{-9}	2×10^{-5}	2×10^{-9}
(α,β^-,γ,e^-)	(Insol.)	Lung	.....	.....	7×10^{-10}	.....	2×10^{-10}
$_{90}$Th-Nat	(Sol.)	Bone	0.01	3×10^{-5}	2×10^{-12}	10^{-5}	6×10^{-13}
(α,β^-,γ, e^-)	(Insol.)	Lung	.....	.....	4×10^{-12}	.....	10^{-12}
$_{92}$U-Nat	(Sol.)	Kidney	5×10^{-3}	2×10^{-3}	7×10^{-11}	6×10^{-4}	3×10^{-11}
(α,β^-,γ,e^-)	(Insol.)	Lung	.....	.....	6×10^{-11}	.....	2×10^{-11}
$_{94}Pu^{239}$	(Sol.)	Bone	0.04	10^{-4}	2×10^{-12}	5×10^{-5}	6×10^{-13}
(α,γ)	(Insol.)	Lung	.....	.....	4×10^{-11}	.....	10^{-11}

* w-water; a-air

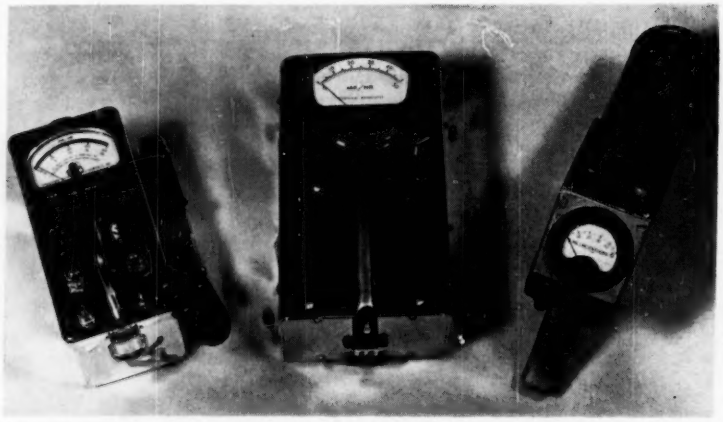
the internal hazard potential. For example, in the case of tritium (super "heavy" hydrogen) and Na-24 the whole body is involved. In the case of iodine, the thyroid is the principal site of deposition. In the case of plutonium, the critical deposition sites are the lung, if the element matter is insoluble, and the bone marrow, if it is soluble.

To date, there is no record of a fatal human exposure from internal deposition of radioactive materials. However, chronic exposure of uranium mine workers in Czechoslovakia to radon gas and other potentially toxic elements in the air,[9] and exposure of radium-dial painters from ingested radium and mesothorium salts[10] has produced lung cancer, bronchial carcinoma and bone tumor fatalities.

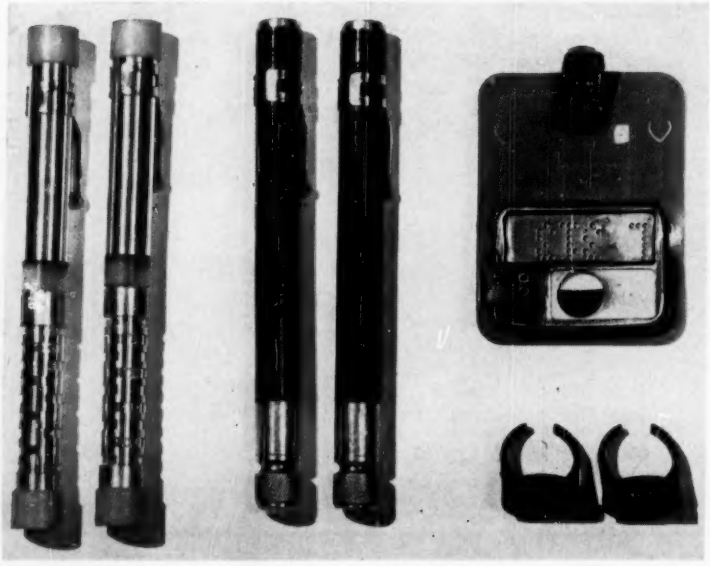
Safe Exposure Levels

Radiation safety must be considered in the design of facilities and equipment, in planning operational procedures, and in the training of employees. Concurrent with these, the need develops for radiation safety standards, radiation detection and measurement methodology and accident prevention programs and control of radiation exposure. All these aspects are necessary to prevent (1) fatalities and injuries of employees, (2) loss of property through contamination of facilities with radioactive materials, (3) development of public relations problems because of radioactive waste disposal into the environment, (4) loss of trained employees through overexposure, and (5) employee concern over safety. Municipal, state[11] and federal code requirements for employee and public safety[12] must all be fulfilled.

Considerable biological and medical research is going on to



COUNT and dose-rate meters: Geiger-Muller (left), Juno, Cutie-Pie (right) measure radiation levels—Fig. 2



PERSONNEL dosimeters: beta-gamma (left), film badge (upper right), film ring (lower right) measure total exposure—Fig. 3

determine the specific mechanisms of radiation exposure effect on biological systems, and on biochemical approaches to minimize adverse radiation effects on biological systems. But sufficient knowledge is now available from actual experience and experimentation to set maximum permissible limits of human exposure to radiation.

The current recommended limits are based on minimizing any demonstrable evidence of injury and minimizing the incidence of adverse genetic effect in progeny. The concept of reasonable acceptable risk must be associated with the radiation-exposure limits. Another concept that should be considered is that radiation exposure should be on a need basis—all unnecessary exposure should be avoided. With those concepts in mind, the following maximum permissible limits have been advanced by the National Committee on Radiation Protection and Measurements and are generally followed in industry:[4, 13]

Organs	Max. Dose
Whole body irradiation, eyes and gonads	3 rem/3 mo., 12 rem/yr., 5 x N (N over 18) rem
Head, hands, forearms, feet and ankles	75 rem/yr.
Single internal organs other than eyes and gonads	15 rem/yr.

These measurements are in terms of rems,* which is a measure of absorbed radiation dose that factors in biological sensitivity as well as the energy absorbed, and in terms of, N, the age of the individual.

As for internal deposition of radioelements, the maximum body burden for radium is 0.1 μc (microcurie or 2.2×10^6 atoms disintegrating/min.) and its equivalent for other bone seeking radioelements, e.g., plutonium, Sr-90 and P-32. All other organ depositions are based upon an upper limit of exposure of 15 rem/yr. with the exception of the thyroid and skin, where the upper limit is an annual dosage of 30 rem/yr.

With respect to radiation levels outside the controlled areas (areas not under surveillance for radiation protection reasons), the maximum permissible levels are reduced by a factor of 10 for external and internal irradiation.

The NCRP and M issues a separate handbook which expresses maximum permissible body burdens and concentrations of numerous radioelements in air and water for occupational exposure based on a 40-hr. week and 168-hr. week.[13] See the table for some common radioelements.

How to Monitor Radiation

Radiation passing through a medium usually ionizes that medium. Both physical and chemical effects are produced in matter as a consequence of this phenomenon.

Another radiation effect on matter is the nuclear one in which radiation is absorbed by the nucleus of an atom producing an artificially radioactive element:[14]

$_{13}Al^{27} + {}_2He^4 \rightarrow {}_{15}P^{30} + {}_0n^1$ (neutron)

$_{15}P^{30} \rightarrow {}_{14}Si^{30} + {}_1e^0$ (positron)

where $_{14}Si^{30}$ is a stable element.

*One rem is the dose of any ionizing radiation that will produce the same biological effect as that produced by one roentgen of high-voltage X-rays.

These two types of reactions (ionization and activation) of radiation with matter are widely employed to detect and measure radiation for health protection purposes.

The ionization principle is used in three ways: in ionization chambers, in proportional counters and in Geiger-Muller counters. The ionization chamber collects ions formed by radiation and measures charge or current produced. In the proportional counter, ions formed by radiation are accelerated by an applied voltage big enough to cause these ions to produce more ions by collision. This increases sensitivity of the ion chamber. In the G-M counter, an even greater accelerating voltage is used, such that any ion pair will cause a complete discharge of the counter volume.

The ionization process is generally relied upon to measure X-rays, gamma rays, alpha radiation, beta radiation, and neutrons.

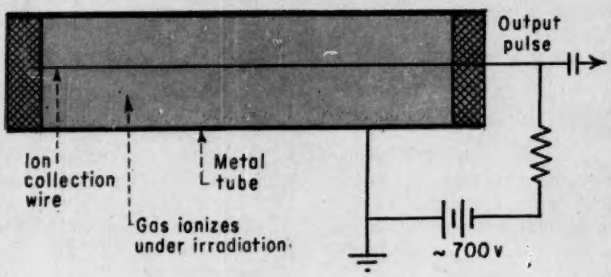
Alpha particles are distinguished by large mass, dense ionization, and limited range. Beta particles have more range and penetration than alpha radiation. Gamma photons and X-rays easily penetrate materials and are easily detected. Depending on the problem, detectors can be designed having a high sensitivity to one form of radiation and low sensitivity to other kinds.

The Geiger counter (Fig. 2, 4) which may be operated either in the proportional region or the Geiger-Muller voltage region, measures radiation (number of gamma photons) emitted per unit time when the pulses of the Geiger counter are amplified and transmitted to a scaling unit. It is usually used to detect the presence of radiation.

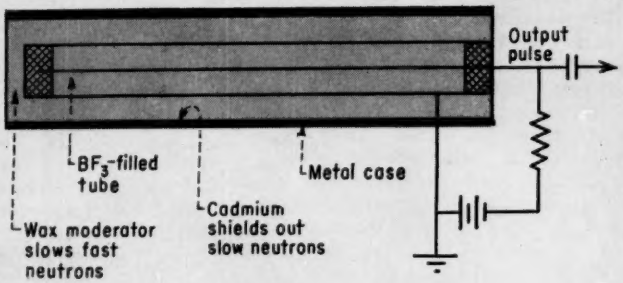
Typical examples of other applied health physics instruments using the ionization principle are air-ionization dose-rate meters, pocket meters and film dosimeters. (Fig. 2, 3).

The activation process is used for neutron measurements. But neutrons are really detected indirectly by ionization since the reaction method generates protons (H^+) through collision of a fast neutron with a hydrogen atom. Ionization produced in air or in other medium by the protons are then measured or the fast neutrons moderated (slowed down) to thermal energy level and measured as slow neutrons through an activation reaction in a

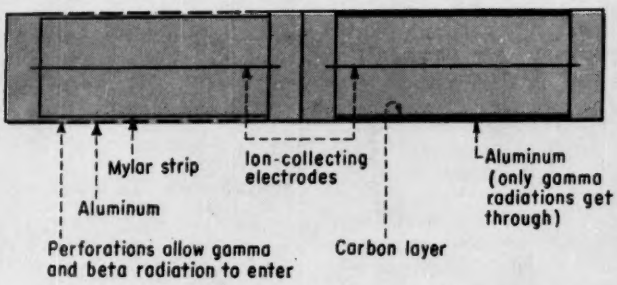
Geiger Counter Detects Radiation—Fig. 4



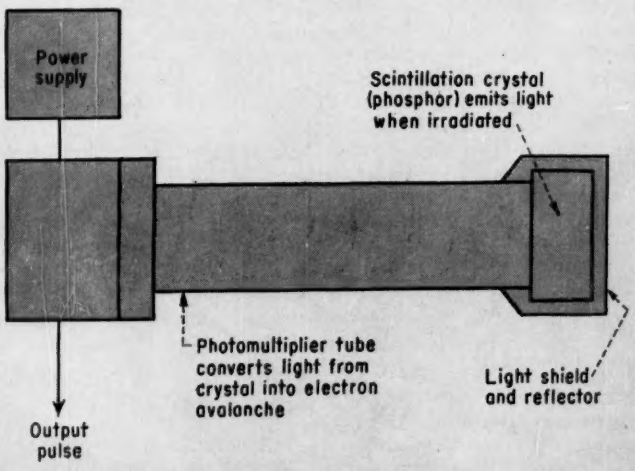
BF_3 Tube Gives Warning of Neutrons—Fig. 5



Beta-Gamma Dosimeter: Daily Total—Fig. 6



Scintillation Meter: Light Into Electrons—Fig. 7



BF_3 counter (Fig. 5). The reaction is based on:

$_5B^{10} + _0n^1 \rightarrow _3Li^7 + _2He^4$ (alpha particle).

The BF_3 counter, whether used as a fast neutron or thermal neutron measuring device measures the flux of neutrons emitted per unit time (nv./cm.²/sec.).

Measuring Total Exposure

Typical instruments used as personnel dosimeters (which measure cumulative radiation) are (1) the film badge (Fig. 3) used as a total body monitor, (2) the finger ring (Fig. 3) used as a hand monitor and (3) the beta-gamma pocket dosimeters (Fig. 3), usually used to measure total radiation on a daily basis as a control monitor.

The film monitors are generally worn for one week as hand monitors and one week to one month as total body monitors. Film is calibrated with appropriate gamma and beta sources and film darkening (film density) measured by a Densitometer. Film worn in badges is processed together with the calibrated film.

Continuing with personnel dosimeters, Fig. 6 illustrates a condenser device (combination beta and gamma dosimeter). Voltage applied to the center electrode is discharged by ionization in the chamber. A relationship between the voltage discharged by radiation is established as measured by an electrometer and as calibrated by a gamma source (Fig. 1).

Personnel monitoring data representing each individual's cumulative record of exposure is maintained indefinitely on punched cards. The recent trend is for placing personnel exposure records on electronic data process systems to expedite evaluation and reporting of information. The personnel monitoring data discussed here is the integrated dose of radiation to which an individual is exposed during the period of personnel monitor use. These data are then interpreted relative to the maximum permissible doses recommended by the NCRP.

Measure Dose Rate

In addition to count-rate and flux meters which determine radiation levels, and personnel dosimeters used to measure total integrated dose of radiation exposure of personnel; dose-rate meters such as the Cutie Pies and Junos (Fig. 3) are widely employed.

The Cutie Pie design is actually an ionization chamber and illustrates the principle of air-ionization measurement. Electrons produced by ionization in the shell air by radiation are collected by a central electrode. The pulse is amplified and measured as current. Through proper calibration, current readings are related to actual dose rates (mr./hr. or mrad./hr.), not just a simple count.

The chamber or shell must satisfy certain technical requirements for the proper measurement of gamma or X-ray radiation. The instrument is made sensitive to beta radiation by a window thin enough to permit penetration of beta radiation but thick enough to filter out alpha radiation.

Junos have two shields so that alpha, beta, and gamma radiation can be detected and measured. When used as alpha meters, the Junos permit determination of alpha-surface contamination of work area surfaces. The greatest use of Cutie Pie and Juno instruments is, however, to determine gamma and beta levels in radiation areas to establish safe-working time limits.

Scintillation Machines

While we, in this article, cannot do justice to the wide variety of instrumentation employed in the health physics field, let alone in the nuclear-energy application effort, it is important to point out that scintillation counters are finding increasing application for radiation measurements (alpha, beta, gamma and fast neutrons).

These counters employ various phosphors which emit photons of light in response to radiation. The light photons are amplified sufficiently to generate a measurable signal (Fig. 7), proportional in intensity to the radiation source. Scintillation counters are more sensitive than simple Geiger counters, but are more costly, bulky and must be operated in a controlled-temperature room.

ACKNOWLEDGEMENT

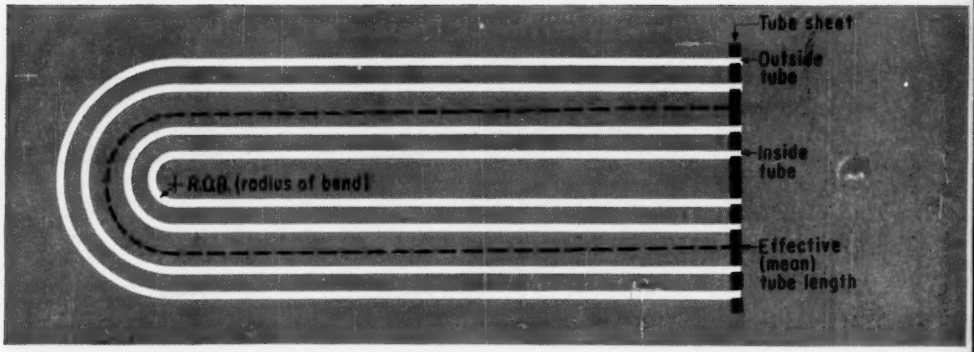
Appreciation is expressed to Miss M. R. Kennedy and Mr. G. W. Gasper of Knolls Atomic Power Laboratory for help in preparing this article.

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In exchanger design, correction chart helps . . .

Find Effective Length of U-Tubes

D. L. WHITLEY and E. E. LUDWIG, Dow Chemical Co., Texas Div.

One problem in designing U-tube heat exchangers is to determine the effective length of the tubes. The effective tube length l_e of the bundle is the mean of the tube lengths between the outside tubes and the inside tubes as shown above. The correction chart shown in Fig. 2 will help you find the effective length without tedious calculation.

Heat exchanger tubes are usually available in even lengths of 8, 10, 12, 14, 16, 24 and 32 ft. When U-tube bundles are made from 12-ft. tubes, for example, the maximum length tube in the bundle is 12 ft. and is in the outside tube row. The inside tube is the shortest and is less than 12 ft.

Since heat exchanger designers must consider many combinations of tube lengths, shell diameters, number of passes, number of tubes and tube size and pitch, it is time-consuming to find effective length for each combination.

When calculating an optimum U-tube exchanger, most designers estimate effective tube length for each combination considered. After a specific design is chosen, the effective tube length is determined accurately. If the estimated length is significantly different from the actual length, a new, repetitive calculation must be made. This operation is tedious even for one tube bundle.

It is to avoid this repetitive calculation that the correction chart has been devised.

The chart may be used most generally as follows:

Area comparison—Table I

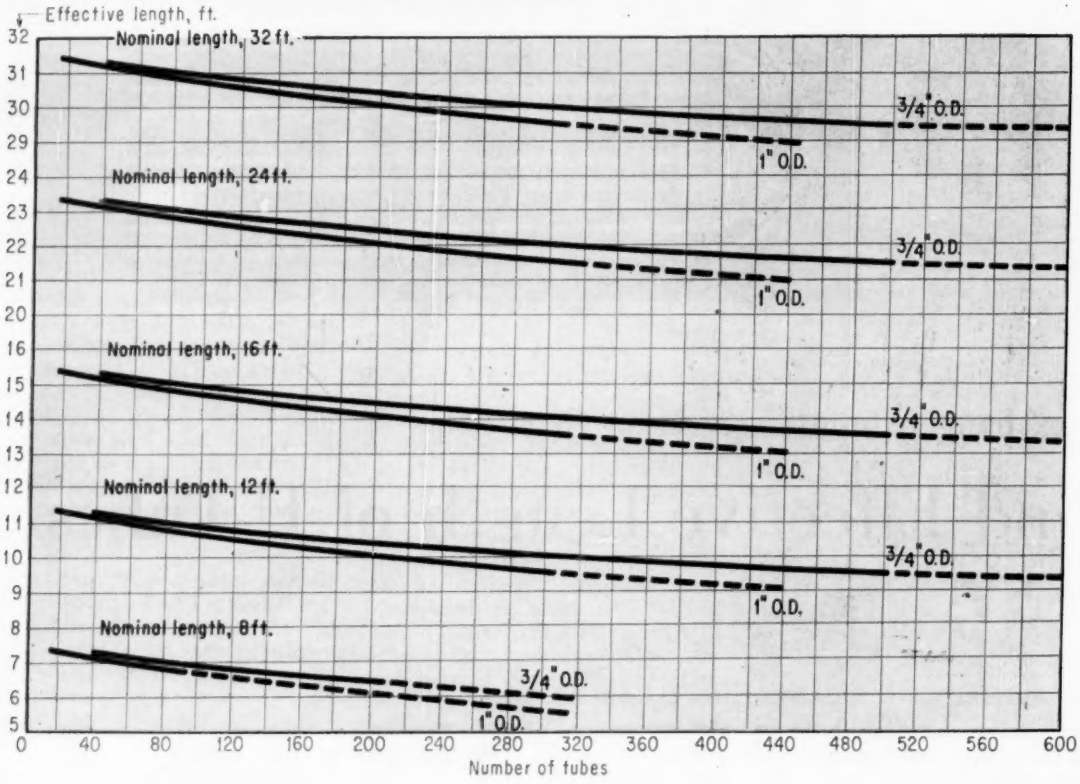
No. of U-Tubes	Tube Size	Tube Pitch	Inside R.O.B.	Area, Calc'd* Sq. Ft.	Area, Act., Sq. Ft.	Error, %
66	¾ in. O.D. x 32 ft.	1 in. □	2 in.	400	405.7	+1.43
212	1 in. O.D. x 32 ft.	1¼ in. △	1½ in.	1,655	1,703	+2.90†
88	¾ in. O.D. x 32 ft.	1 in. □	2 in.	534	533	−0.19
54	1 in. O.D. x 32 ft.	1¼ in. □	3 in.	439	448	+2.05

Note: R.O.B. = Radius of bend.
* The calculated areas were based on Fig. 2 using only the tube size and number of tubes.
† This deviation may be due to error in the actual area.

Plotting values for effective length—Table II

Nominal length	32 Ft.		24 Ft.		16 Ft.		12 Ft.		8 Ft.	
Tube O.D., in.	¾	1	¾	1	¾	1	¾	1	¾	1
No. Tubes										
12	—	31.40	—	23.40	—	15.40	—	11.40	—	7.40
36	31.25	—	23.25	—	15.25	—	11.25	—	7.25	—
100	30.70	20.80	22.70	22.80	14.70	14.80	10.70	10.80	6.70	6.80
200	30.10	30.35	22.10	22.35	14.10	14.35	10.08	10.35	—	6.35
300	29.57	29.98	21.57	21.98	13.57	14.00	9.56	10.00	—	—
400	—	29.70	—	21.70	—	13.70	—	9.70	—	—
500	—	29.48	—	21.48	—	13.48	—	9.48	—	—

Chart Showing Effective Tube Length Correlations—Fig. 2



• To give effective tube length if the number, length and size of tubes are known.

• To give the number of tubes if an effective length is assumed and the length, size and outside surface are known.

Values read from the chart are not more than 1% lower than calculated values, except where the curves are extrapolated to lower tube counts. Such extrapolations result in errors of 3 to 4% (and higher) greater than the calculated values. This does not apply to higher tube-count extrapolations. The chart is limited to ¾-in. and 1-in. O.D. tubes and the accuracy of extrapolation to other diameters has not been found.

The chart can be used for both low-finned tubes and plain tubes but is restricted to either two or four tube passes. For arrangements other than those used in the chart preparation, the designer must use his discretion. Table I is a comparison of calculated areas with actual areas for various U-tube bundles installed in a chemical plant.

Examples

1. Given a U-tube bundle with 168 plain tubes, ¾ in. O.D. x 16 ft. (nominal), find the total effective exposed area.

From Fig. 2, the effective length is 14.5 ft. and the total effective area is:

$$(14.5)\,(168)\,\pi\,(0.75/12) = 478.3 \text{ sq. ft.}$$

2. Given low-finned tubes (19 fins/in.), 1 in. O.D. x 12 ft. (nominal), with an outside area of 0.678 sq. ft./lin. ft. The exposed area of the bundle is 2,142 sq. ft. How many tubes do we need for this bundle?

A trial-and-error procedure is required. First, assume effective tube length is 11 ft. The number of tubes needed is:

$$2{,}142/(11 \times 0.678) = 288$$

From Fig. 2, effective tube length for 288 tubes is 9.6 ft.

Calculate a new number of tubes:

$$2{,}142/(9.6 \times 0.678) = 330$$

Now, the effective tube length is 9.42 ft. Calculate a new number of tubes:

$$2{,}142/(9.42 \times 0.678) = 336$$

The effective tube length for 336 tubes is 9.4 ft. Thus, we need 336 tubes.

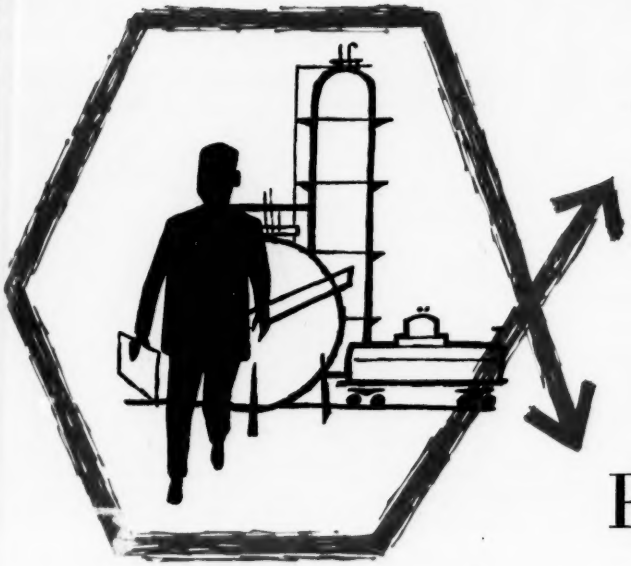
Space limitations do not permit printing Fig. 2 large enough for accurate calculations. Table II is a set of values from which you can plot a larger chart.

Basis for chart: ¾-in. tubes with min. rad. bend of 1.5 tube dia. and 1 in. tri. pitch; 1-in. tubes with min. rad. bend of 2.5 tube dia. and 1.25 tri. or sq. pitch; tubes on exchanger centerline; ¾-in. clearance between bundle and shell; 1.5 in. thick tube sheet.

ERNEST E. LUDWIG is process engineering manager for the Dow Chemical Co., Texas Div. See *Chem. Eng.*, June 13, 1960, for Ludwig's 48-page report on Flow of Fluids.

DONALD L. WHITLEY is also with Dow's Texas Div. where he is a chemical engineer in Ludwig's group.

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Systems Engineering, Part 6

Plant Studies

With our plant on stream at last, troubles have arisen. Project engineer's problem: Has systems design failed? Systems engineers' answer: No, but we can help you.

THEODORE J. WILLIAMS, Monsanto Chemical Co., St. Louis, Mo.

In previous chapters of Systems Engineering,* we have reviewed historical development in the CPI and contributions of disciplines outside chemical engineering. Following this extended "definition," we introduced the hypothetical process problem and carried it through research, development and design. Now the plant to produce *P* is on stream, but project engineer Joe X. Smirk's responsibility has not yet ended.

MEMO

TO: Systems Engineering Group
FROM: Joe X. Smirk

What ever made me decide to use your "services" in designing this plant? We've had nothing but trouble since startup, never have gotten up to capacity. There seem to be plant upsets 10-12 times a day, and we keep ending up with off-spec product and poor yields. Can any of you smart guys bail us out? Despite our trouble now, I can't help but think that the bulk of your work was good and timesaving. Where did we go wrong?

MEMO

TO: Joe X. Smirk
FROM: Systems Engineering Group

There's no point in our being recriminatory, Joe, because the main point is to get that plant going. But we warned you during the design stage that we hadn't completed our full program. We didn't optimize the design for individual units but only for the over-all plant. You cut us short then with a memo that you wanted to get the construction show on the road. We suggest now, if it's OK with you, that we send a team into the plant, make some tests during operation and then advise a course of process improvement. Later, perhaps, we can show you how this situation could have been avoided and can be avoided in any future work.

Joe has called in the systems engineering team to study the plant's operation and to recommend steps to be taken to secure a more stable process and to assure maximum return on investment. Normally we would not know as much about the economics of the operating plant when going in to make tests as we do in this case. One of the first, and probably most profitable objectives of the systems study would be development of such information.

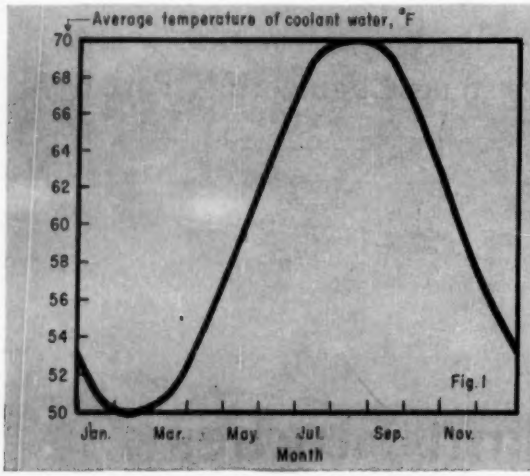
Sources of Plant Upsets

First on-site task of the team when undertaking a study of an operating plant is to determine sources and magnitudes of any upsets that might affect plant operation and to establish actual capacity of each unit.

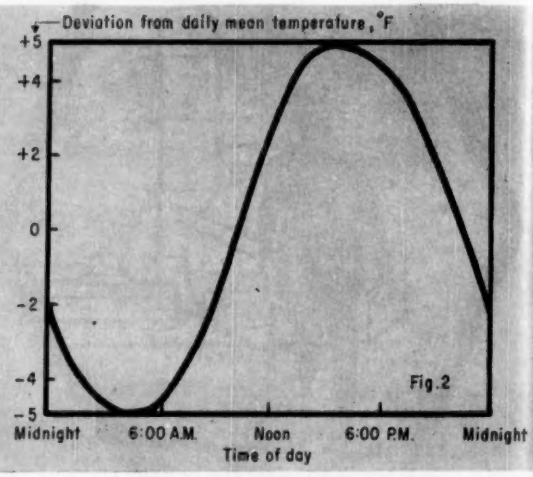
We have found, in this case, that there are two main sources of variations in plant operation and efficiency:

- First of these is a large but regularly fluctuating variation in cooling water and raw material feed temperatures due to diurnal and seasonal variations in ambient conditions.
- Second source of trouble is fluctuation in supply

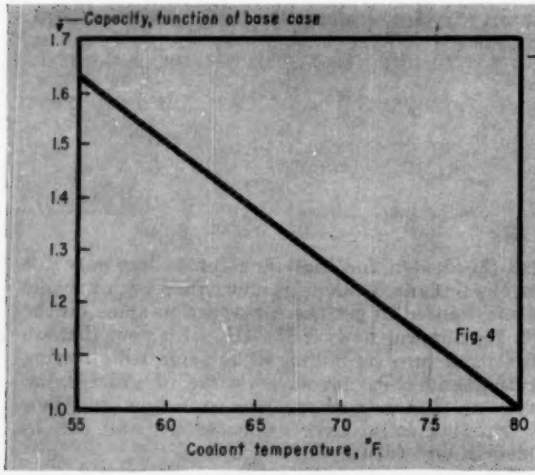
* Based on the 1959 Schoch Lecture at the University of Texas, the series has appeared in *Chemical Engineering*, Feb. 8, 1960, pp. 121-6; Mar. 7, 1960, pp. 131-6; Apr. 4, 1960, pp. 139-44; May 2, 1960, pp. 121-6; May 30, 1960, pp. 97-102.



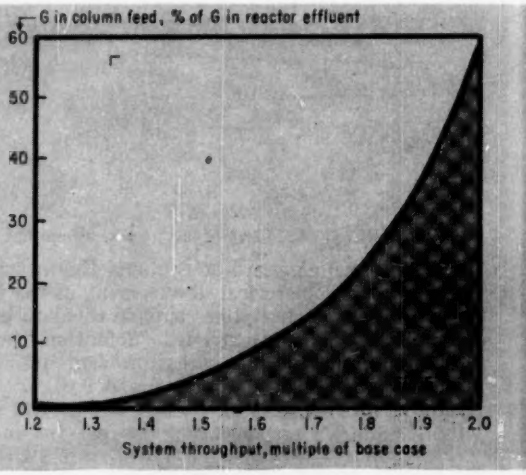
SEASONAL variation of water temperature.



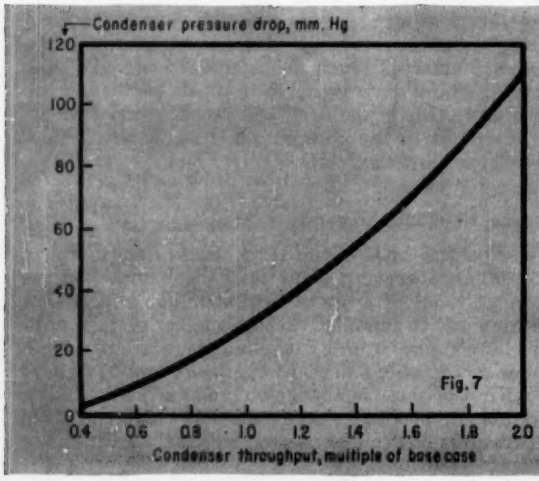
DIURNAL variation of water temperature.



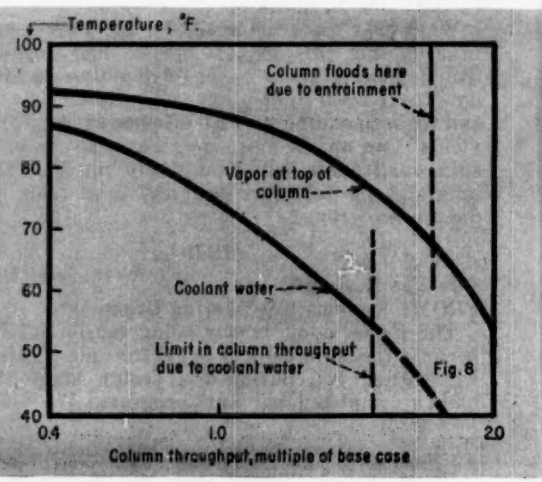
CAPACITY of reaction-cooler heat exchanger.



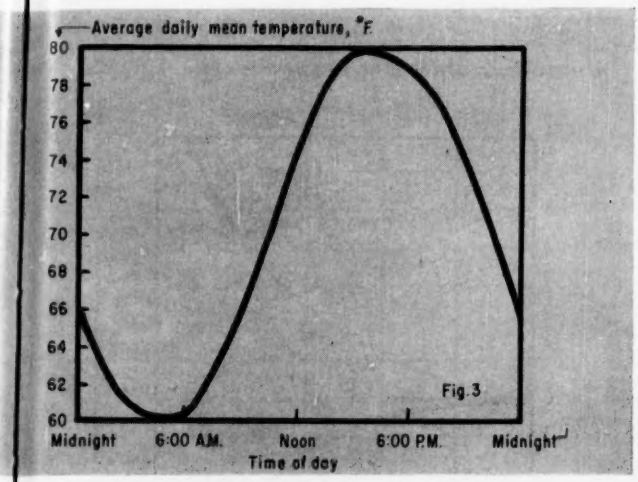
SYSTEM flow rates affect decanter performance.



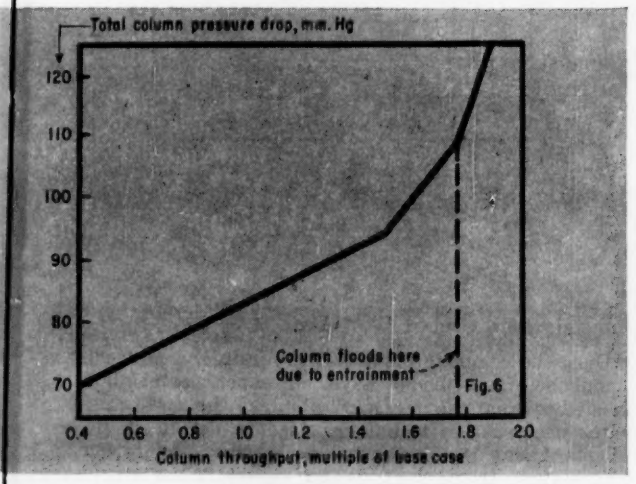
TOTAL condenser pressure drop.



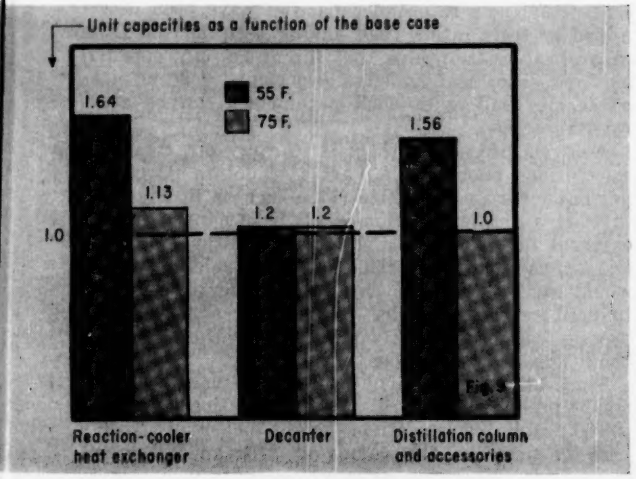
COLUMN vapor and coolant temperatures.



DIURNAL temperature of feed streams.



OVER-ALL column pressure drop.



COOLANT temperature affects capacities.

of reactant A to the process. Reactant A, as noted during preliminary design evaluation, is manufactured in another producing unit of the same plant complex. In addition to supplying the plant to manufacture P, the other unit supplies A to several batch processes in the complex. Result is considerable fluctuation in supply of A to our process whenever a batch process is charged.

Let's examine the data we have collected in our plant that show these situations. From an average of a large amount of data taken over several years' time for cooling water temperatures, and from reactant stream temperatures taken since startup, the graphs shown in Figs. 1-3 were obtained. A random fluctuation present in these temperatures has been smoothed out here.

As for the second trouble-spot, reactor feed fluctuation, the actual external batch-filling cycle is random due to number and variability of operation of these other reactors. Effect upon availability of A to our process reactor, however, was found to be characterized by

$$F_A = 14{,}500 \pm 2{,}100 \text{ lb./hr.} \quad (1)$$

where variation of ±2,100 lb./hr. can be considered a positive or negative step function with an average repetition rate (one complete cycle including both plus and minus variations) of once per hour and an apparent maximum duration at any one state of two hours.

Test Equipment for Capacity

Capacity tests were then made of the purely physical capacities of reaction-cooler heat exchanger, decanter and distillation column and its accessories.

Heat exchanger capacity was found to be principally a function of cooling water temperature as shown in Fig. 4. Decanter capacity is influenced by time required to assure separation of heavy oil G phase from the cooled reaction effluent stream. Too high a decanter throughput will therefore result in carryover of G into column feed stream as shown in Fig. 5.

Ultimate column capacity is determined by flooding rate, but capacity can be limited prior to this point if coolant water temperature is not low enough for condenser capacity to match required column vapor rate. Fig. 6 presents column pressure drop data, and Fig 7 shows same for condenser. Resultant vapor temperatures and required coolant temperatures, assuming current base still-pot pressure, are given in Fig. 8. This still-pot pressure should be maintained to prevent possibility of overheating and thus further unwanted reaction in the reboiler.

Base case considered in these capacity tests is that of Table III, Part 3 of Systems Engineering. Relationship of capacities of these units at two possible cooling water temperatures is shown by the bar graph of Fig. 9.

Testing the Reactor

The most important plant unit in our study and the most difficult to test is the reactor. Because of the reactions with their multivariable dependency, simple physical capacity tests such as were performed on the other plant units are not sufficient for our purposes. What's needed is a complete theoretical kinetics analy-

sis (as covered in Part 2) or its equivalent in the form of statistically derived equations from regression analysis of designed-experiment data.[1]

Because it can be used for the same reaction regardless of reactor or reaction conditions, the complete theoretical kinetics analysis is by far the more desirable; it has permanent value beyond the specific plant study. However, where time is not available for complete study, or where there are an excessive number of components or reaction steps, or where insufficiently explained catalytic actions occur, a statistical approach might be the only way.

Since it was not emphasized in Part 2, note that catalysts also can be readily treated in a theoretical kinetics analysis. Homogeneous catalysts are best treated as additional components in reaction mixture; their concentration effect in solution indicates their action is of this type. Heterogeneous catalysts, however, must be treated as modifiers of kinetic rate constants, because their concentration cannot be adequately expressed.

For the heterogeneous case,

$$k = f(T, C) \tag{2}$$

or better,

$$k = fe^{-f'(C)/T} \tag{3}$$

since both frequency factor A and activation energy B of the Arrhenius relation can be functions of catalyst activity, i.e., $f(C)$ and $f'(C)$ respectively.

Statistical analysis results in a set of equations for the reactor which have the following form:

$$F_R(C) = aF_A + b(F_A/F_B) + cT + dT^2 + eF_L + \ldots \tag{4}$$

$$F_R(G) = hF_A + i(F_A/F_B) + jT + kT^2 + lF_L + \ldots \tag{5}$$

$$F_R(I) = pF_A + q(F_A/F_B) + rT + sT^2 + tF_L + \ldots \tag{6}$$

Note particularly that statistical analysis has no possibility of picking up presence of components C and E or of detecting effect of the azeotrope on analysis of P unless data on these are available from an independent source. Too, unless reaction is carried out in a variety of different reactors during tests, the resulting equations will be specific to the particular reactor tested.

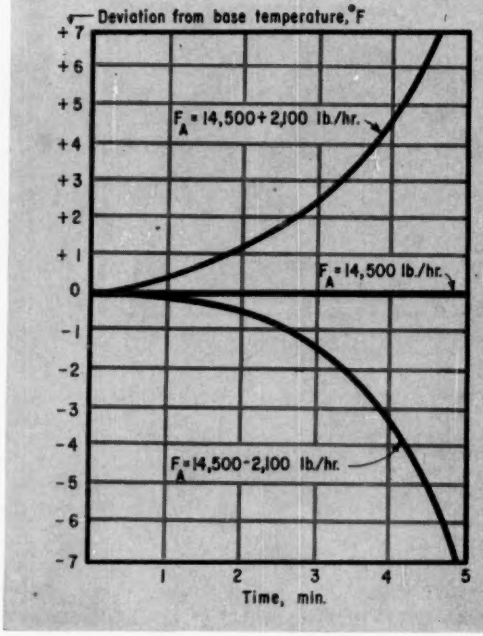
Despite these drawbacks which must be recognized and kept in mind, the statistical approach is extremely valuable and is widely used for the reasons mentioned above.

Process Dynamics Testing

Data on the stability problem of the plant are also taken during the on-site team study. A wide, cyclic temperature fluctuation occurs whenever the reactor is subject to decrease in available reactant A caused by changing external batch requirements.

For any piece of processing equipment for which suitable dynamic equations cannot be written, a response analysis must be made. Our analysis of the operating plant must effectively follow the same steps as previously outlined for satisfactory design of a new plant. Experimental dynamic data can be obtained by standard frequency response methods,[3] by auto- and cross-correlation techniques[3, 4] and by pulse tests.[5, 6] Any of these is satisfactory if proper procedures outlined in the cited references are followed.

Uncontrolled Reactor Response—Fig. 10.



Analysis and Use of Test Data

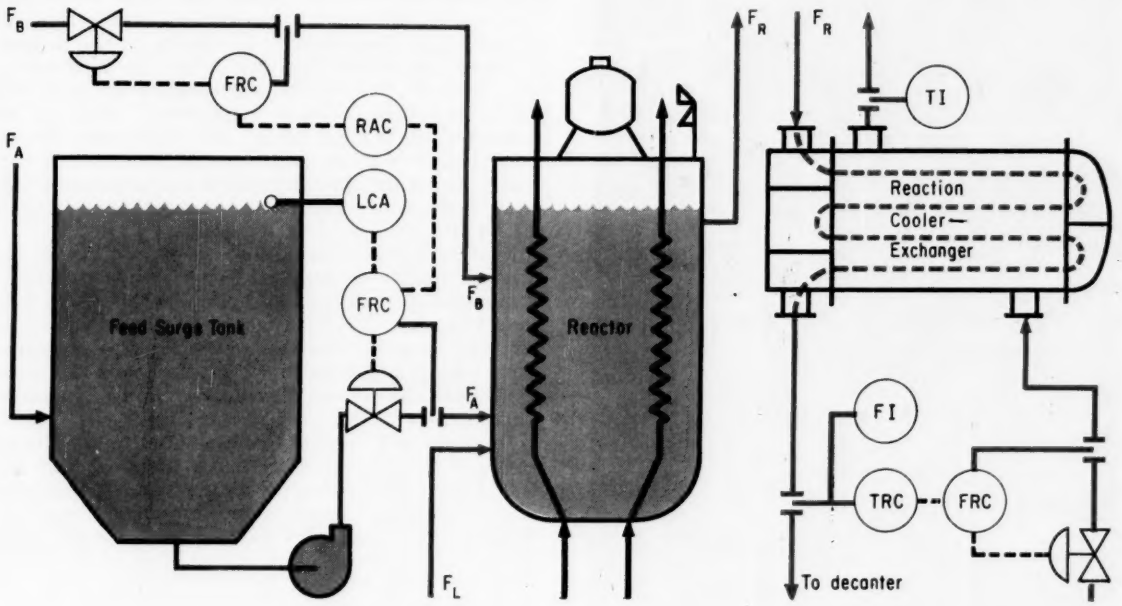
Once the complete plant test program has been accomplished, we should have all experimental data needed to treat the operating plant by the same computer optimization techniques used in design stages (Parts 4 and 5). These data plus sizing and rating information from plant design reports allow us to readily derive dynamic relationships as in Part 4.

These relationships now have the added advantage that actual flow rate and capacities have been determined by tests rather than having been derived from theoretical relationships that might be only approximations. Too, heat transfer coefficients, column plate efficiencies and other such parameters can be accurately specified.

Analysis procedure, then, is to carry out computer calculations described in Part 4 to obtain graphs of percent return vs. variable value such as in Figs. 5-8 in Part 4 for process under study. Changes in any external factor—cooling water temperature (Figs. 1 and 2), raw material prices, projected sales market—would each require a series of computer calculations to produce these graphs. This is necessary so that process can be held at optimum operation level for conditions at a particular time.

Since all possible variation in these variables cannot be predicted during initial optimization, and since some postulated variations might never occur, it's best to preserve the computer program after it's proved out. Whenever a change occurs in plant operation conditions, the computer program can be rerun

Changes in Plant Flowsheet Instrumentation—Fig. 11.



to obtain specific optimum operating levels. Such an optimization, run on an off-line, large-scale computer, takes only minutes.

Plant Process Control Analysis

If necessary, the systems engineering study of an operating plant also can provide information necessary to improve plant controllability. We may want to smooth out plant fluctuations, or we may wish to make it easier to set operating adjustments required to maintain optimum operating levels.

The project engineer's design, presented in Part 5, Fig. 2, showed some conventional instrumentation practice. An adequate dynamics study, considering individual equipment units, would provide a basis for specifying better instrumentation in some parts of the flowsheet. But tests are often most effective and economical when used in conjunction with computer simulation.

Much information which can be derived from computer simulations in design stage can also be obtained —and more exactly—by plant test. As analysis proceeds, requirements for additional data can often be more easily satisfied by computer simulation then by returning to the plant for more test data. And simulations are more accurate because some plant data are now available to corroborate them.

Of course, the foregoing implies that sufficiently large computers are available for simulation. Otherwise the plant is the only source of data necessary to complete the optimization study.

Changes in Equipment and Instrumentation

Let's now consider changes which individual unit simulation, relegated to limbo by the project engineer during design, would indicate for our plant.

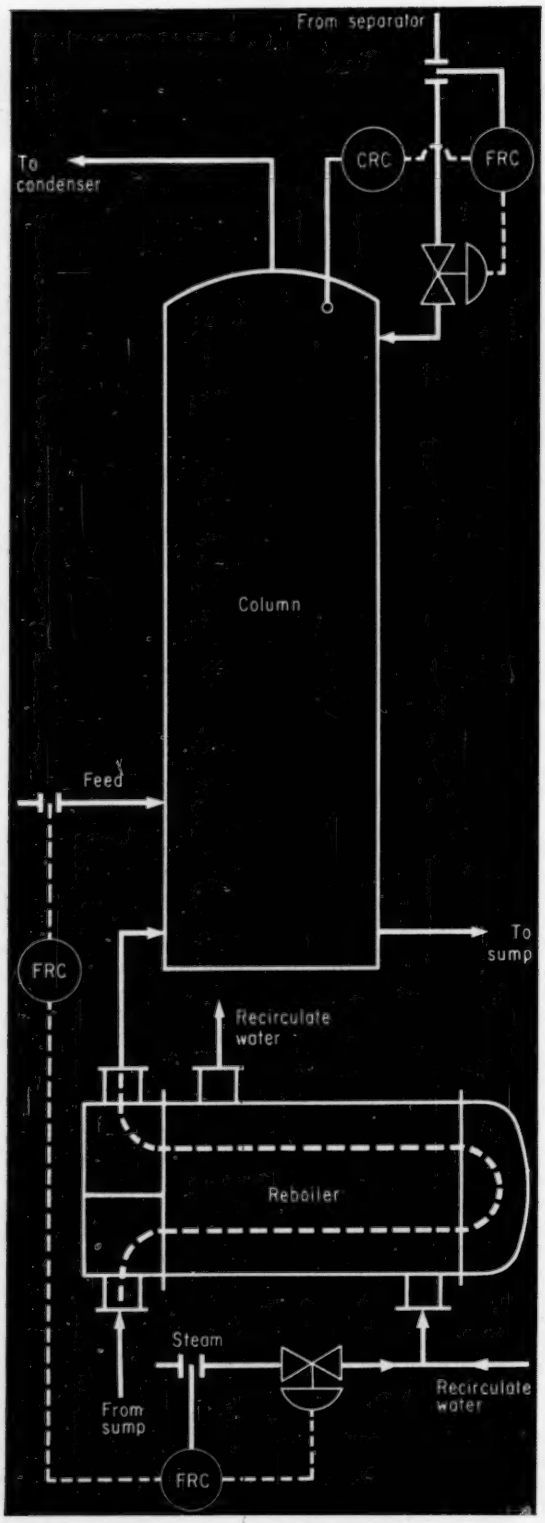
Feed Surge Tank—Fluctuations in supply of reactant *A* caused by charging other processes in the plant complex make control of the reactor difficult and prove to be the major source of control difficulty. Fig. 10 shows how reactor, with no control, responds to flow rate upset of Eq. (1). Because both positive and negative deviations from required flow occur, the obvious remedy is to install a sufficiently large tank in the line feeding reactant *A* to assure continuous supply to the reactor.

Test data state that the apparent maximum length of time that any specific flow rate is held is two hours, so the tank must have a capacity four times the maximum flow deviation—4 $\times$ 2,100 lb. = 8,400 lb. Since flow fluctuations are random, we must be prepared at any time to handle either a two-hour positive or two-hour negative variation in availability of *A*.

To take care of rare possibility that two, two-hour positive variations might occur at close intervals and overflow the surge tank, a level alarm controller is installed to pass any such upset on to the reactor (Fig. 11).

Reactor Instrumentation—As planned by the process designers, reactor instrumentation originally required manual setting of the desired flow rate F_B of reactant stream *B*. To maintain the proper ratio of *B* to *A* entering the reactor, it's necessary that an

New Column Instruments—Fig. 12



automatic setting of F_B be devised, such as shown in Fig. 11.

Flow rates of A and B can now be completely controlled at desired rates except for those rare times when surge tank capacity might be too small. Ratio of F_A and F_B, so important to economics of the process, is set and maintained by ratio controller between the two streams. For clarity, the temperature and level control instrumentation is not shown in Fig. 11, but it remains as in the original. And since some fluctuations of F_A and F_B are still possible, temperature control loops for the reactor must still be capable of handling temperature excursions of magnitude of those in Fig. 10.

Reaction-Cooler Heat Exchanger—Just as in the original reactor instrumentation, the reaction-cooler heat exchanger most lacks automatic operation. We should not have to depend on manual resetting of instrument setpoint whenever outlet temperature deviations require a change in coolant flow. It's far better to cascade the coolant flow control to a temperature controller, as in Fig. 10.

Decanter and Recycle Control—Control for the decanter is satisfactory with the two original level controls—one at interface to determine discharge flow of G to waste and one at surface to control flow of raw product to the distillation column. Instrumentation for recycle control needs only the addition of a variable ratio controller between the flow controllers on sump discharge and byproduct lines.

Distillation Column Control—Considering all types of upsets, it's been shown[7] that the best all-around control of a distillation column is two-fold:

1. Maintain the ratio of feed rate to column boilup rate constant by slaving the steam flow controller to a flow controller sampling the feed line. Fluctuations of feed rate are then automatically compensated by similar variations of steam feed to the reboiler heat exchanger system.

2. Develop and install a device capable of reading composition directly at top of the column. Since in our case the overhead mixture can be treated as a binary between P and the remainder of the components, spectroanalyzers (infrared, visible or ultraviolet) might be completely satisfactory; otherwise a chromatographic analyzer might be necessary. Analyzer will search for traces of A and B, the next higher boiling components in mixture after P.

Fig. 12 shows the resulting control arrangement. Instrumentation on the column accessories is otherwise sufficient.

Control and equipment modifications introduced as a result of the plant tests should succeed in making plant operation stable and as nearly automatic as conventional instrumentation will allow. Manual setpoint adjustment must still be resorted to in carrying out changes in operation dictated by off-line computer optimization calculations done at regular intervals.

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A SIX-ARTICLE SERIES ON
LOW-TEMPERATURE CONSTRUCTION MATERIALS

- CARBON STEELS
- ▶ ALLOY STEELS
- STAINLESS STEEL
- NICKEL ALLOYS
- ALUMINUM
- COPPER

A-300 Alloy Steels

Serve the −50 F. to −150 F. Range

RICHARD ROTE and JOSEPH H. PROCTOR, Lukens Steel Co., Coatesville, Pa.

In our May 30 issue we published the first of a series of articles on construction materials for low-temperature service, from subzero to the absolute zero. The first article dealt with special carbon steels for use down to about −50 F. Later articles, to appear over the next few months, will cover the materials listed above and will also include a critique from a major designer of low-temperature process plants.—Editor

In the last ten years there has been a tremendous expansion in the production of cryogenic liquids—oxygen, hydrogen and nitrogen to name the most important. In addition, however, we have seen a parallel increase in interest in certain liquids that are manufactured and handled at more moderate, but still low, process temperatures. A typical example here is ethylene. Furthermore, interest has been increasing in materials which resist brittle fracture at low atmospheric temperatures—for example, the conditions of Arctic service.

In this less severe temperature range, say, −50 F. to −150 F., there is a group of ferrous alloys which are well established and well recognized for their usefulness. Although these materials are not as widely known as the materials used in −300 F. service they are very reasonably priced compared with the latter material.

The tendency of ordinary steels to become less ductile—therefore more susceptible to brittle fracture at low temperatures—is well known. There are, in general, three methods of modifying steel to reduce this tendency.

- Modify the internal structure. Fined-grained steels are normally better suited to this type of service than coarse-grained steels. This modification can be brought about by aluminum deoxidation.
- Apply certain heat treatments such as normalizing and stress-relieving. To some extent this is a variation of the method above.
- Add certain alloying elements known to produce toughness in steels—the most common, nickel.

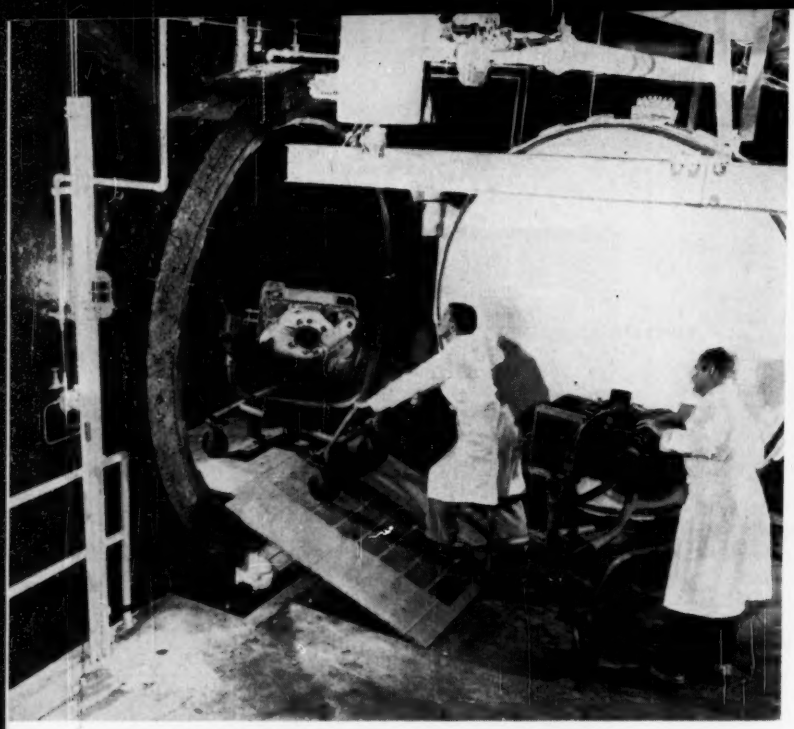
As has been usual in matters of this sort, the ASTM and the ASME Unfired Pressure Vessel Code Committees led the way some years ago in setting up specifications to clarify these various modifications. Thus, for pressure vessel work, they set up the A-300 classification which covers carbon and alloy steels for use at temperatures down to −150 F. In addition, the ASME Code added certain fabrication requirements—such as stress relieving—to insure the suitability in low-temperature service of vessels made from these materials.

A considerable number of steels

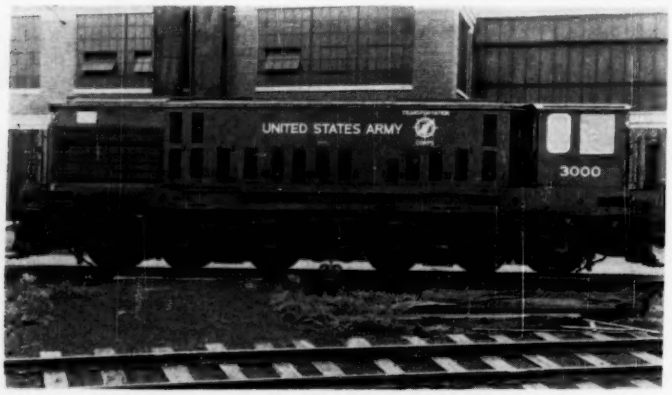
Condensation of ASTM Specification A-300 for Low-Temperature Steels—Table I*

Class	ASTM Specification and Grade	Min. Test Temp., °F.
1	A-201, A-212 flange or firebox quality	− 50
2	A-203, Grades A & B (2¼% nickel), firebox quality	− 75
3	A-203, Grades D & E (3½% nickel), firebox quality	−150
4	A-353	−320
5	A-410	−150

* Notes: (1) A-300 steels are manufactured to fine-grain melting practice and are normalized. (2) Charpy keyhole notch impact tests shall generally not be below 15 ft.-lb. at the test temperature. (3) While it is not included in this specification, T-1 low-temperature steel (shown in Table II) is manufactured and tested according to Class 1 requirements.



Jacketed altitude and cold test chamber fabricated of A-203 Gr. B 2¼% Ni steel for service from −65 F. to +500 F. at pressures simulating 75,000 ft. altitude—Fig. 1

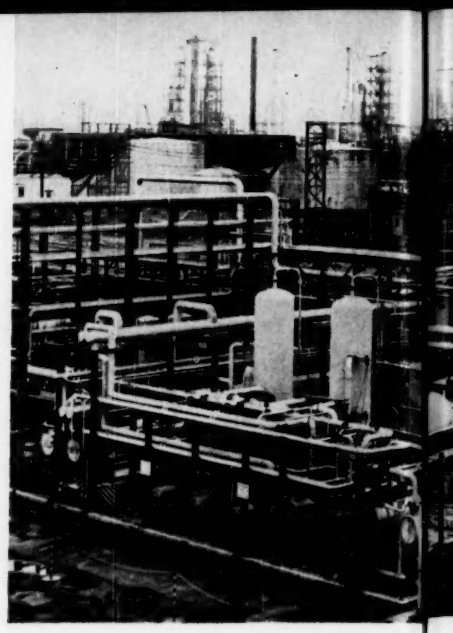


The combination of 100,000 psi. yield strength and low-temperature toughness made T-1 steel a suitable choice for the underframe of this GE-built locomotive for Arctic service—Fig. 3

Allowable Stresses and Approximate Prices for A-300 Steels—Table II*

Steel	Strength, Psi. Tensile	Strength, Psi. Yield (Min.)	Allowable Stress AISC (0.6Y)	Allowable Stress ASME (¼T)	Price, c./Lb.
A-201 Gr. B	60–72,000	32,000	19,200	15,000	7.7
A-212 Gr. B	70–85,000	38,000	22,800	17,500	7.7
T-1	115–135,000	100,000	60,000	28,750	13.5
A-203 Gr. B	70–85,000	40,000	24,000	17,500	13.8
A-203 Gr. D	70–85,000	40,000	24,000	17,500	14.7
A-353	90,000 min.	60,000	36,000	22,500	30.2

* Table gives applicable specifications and allowable stresses. AISC commonly used by designers for structural work, and ASME-UPV for pressure vessel work. Approximate prices shown, based on firebox quality ASTM A-300, are given for comparison.



A-300 Class 3 steel (A-203 Gr. E) was the material used in the low-tempera-

are made to the A-300 classification. Table I shows this classification includes A-201 and A-212 which are specially treated carbon steels for service down to −50 F. Among the alloy steels are A-203 Grade A or B (2¼% Ni) steel for service to −75 F. and A-203 Grade D or E (3½% Ni) steel for service to −150 F. The table also shows A-410, a Cr-Cu-Ni alloy steel for service down to −150 F., but this is not widely used.

The ASME Code permits using carbon steels without special treatment for service down to −20 F. However, various authorities have pointed out that it behooves the designer to consider more rigid material specifications for some services even above +20 F. Fig. 4 shows ductility transition curves for these materials. (See first article of this series, *CE*, May 30, 1960, p. 103, for explanation of transition curves.—Ed.)

Figs. 1, 2 and 3 show typical applications for low-temperature steels. Portrayed in Fig. 1 is a jacketed altitude and cold-test chamber fabricated from A-203 Gr. B for service between −65 F. and +500 F. at pressures low enough to simulate an altitude of 75,000 ft. Fig. 2 is a petrochemical plant having low-temperature heat exchangers for producing isobutylene. This is typical of ASME Code applications of A-203 Gr. E nickel steel, with the steel tested at −150 F. at the producing mill.

Fig. 3, showing a GE-built Army locomotive for Arctic service, re-

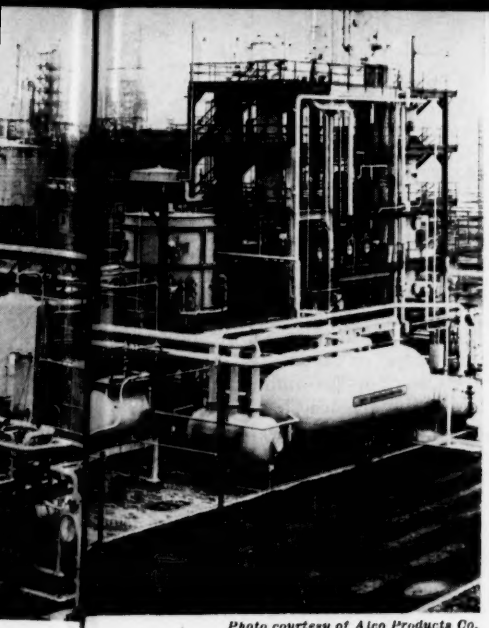


Photo courtesy of Alco Products Co.

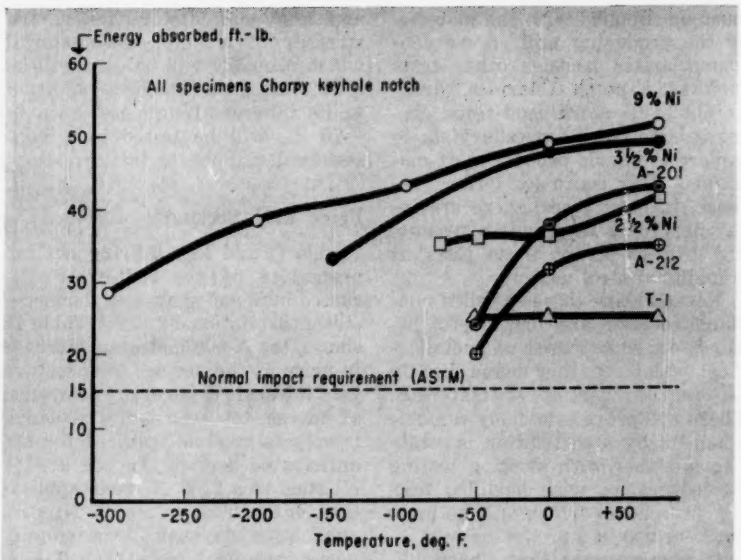
ture heat exchangers of this petrochemical installation—Fig. 2.

quires a little further explanation. In certain cases, for non-Code work, it was found desir le to establish a specification for service at ambient temperatures. This is particularly true when the structure in question is to serve in a geographical location where low temperatures will be encountered. It is evident that the steels listed in A-300 are well suited for this sort of service.

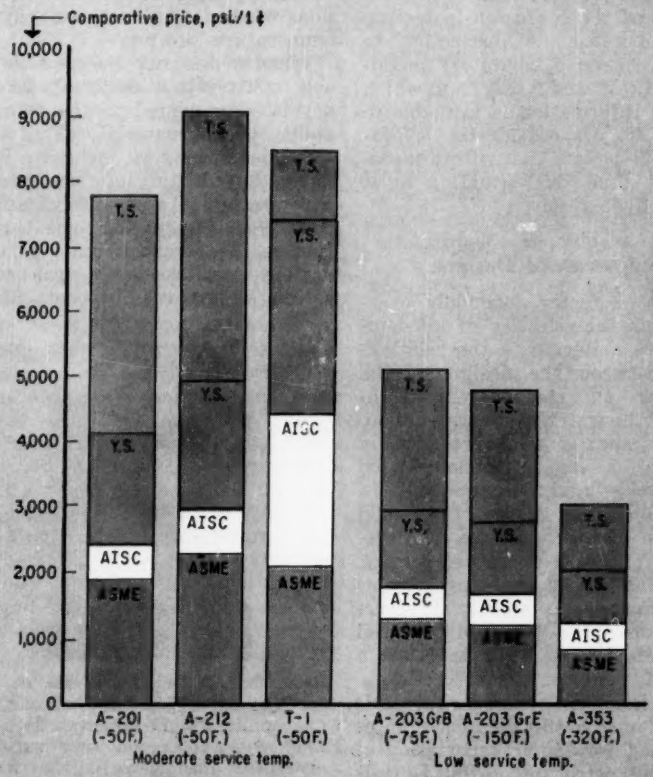
For such sorts of application, particularly where high strength also is required, another type of steel known to T-1 is finding increasing use. T-1 was developed by U. S. Steel and Lukens is the only licensee. It is not specified under A-300 but is included along with the A-300 steels in Table II for cost and strength comparison. Tested similarly to the Class I steels in Table I, T-1 combines high strength and low-temperature toughness. Its 100,000-psi. yield strength permits design of relatively lightweight structures of excellent toughness down to −50 F.

This explains why the locomotive underframe in Fig. 3 is fabricated from T-1 where its lightness is advantageous in the type of terrain common to cold climates.

One factor which beclouds the selection of low-temperature materials today is the great variety of testing criteria used in establishing the suitability of materials for various services. You will note that A-300, as defined in Table I, calls for the Charpy keyhole impact test as the quality-control test which



Typical impact transition curves for low-temperature steels; low-temperature toughness is normally evaluated this way—Fig. 4



Relationship between price and strength for various low-temperature steels, obtained by dividing various strengths by per-pound price; note T.S. and Y.S. are respectively tensile and yield strengths, while AISC and ASME are allowable stresses as specified by Amer. Inst. of Steel Const. and by ASME—Fig. 5

must be supplied with the material by the producing mill. Some confusion arises because other tests such as V-notch Charpies, drop-weight tests, notch-bend tests, etc., are being used by metallurgists to explore the basic properties of materials. The confusion arises because, in most cases, there are insufficient data to permit a producing mill to accept these tests as a quality control measure.

Nevertheless, those so-called nonstandard tests are very useful because, in some cases of metallurgical evaluation, they define slightly different properties of materials. These will prove extremely valuable when finally a correlation is established, either with existing testing procedures, or with modified testing procedures which will be practical for use in a producing mill.

It now appears that Charpy V-notch impact tests are close to the point where they can be accepted as a basis for rejection.

Most of the confusion in testing arises because no distinction is made between a laboratory metallurgical test, and a test from which enough information is available to permit its use outside the laboratory. We believe that within a reasonable time this situation must and will be resolved.

Low-Temperature Design

Another factor commonly overlooked in the selection of low-temperature materials is the relationship between the design of the structure and the inherent toughness of the material of construction. For instance, a notch produced by fabrication—e.g., incomplete fusion in a weld—might be acceptable in normal vessel service, but could initiate a severe failure in structures for low-temperature service. Therefore, it is probably just as important to design out all structural discontinuities and potential crack-starters as it is to select a suitable material of construction.

An excellent example of this situation occurs in the case of ships designed for the transportation of liquefied petroleum gases. LPG is normally a mixture of butane and propane; in liquefying it, it is not expected that service temperatures will be lower than −45 F. Carbon steels would normally be adequate for this job. However, because of the shape of the hold tank of a ship, and the unpredictability of the stresses in a ship, the material which probably will be used will be a 2¼% Ni steel which, in addition to its inherent toughness down to −75 F., will be tested in a nonstandard manner to insure safety.

Price and Strength

Table II and Fig. 5 bring out the properties of the materials discussed here and show also the price-strength relationships. As Table II shows, the A-300 materials increase in price as the service temperature goes lower. It is generally desirable, of course, to use a material which is only as good as required for the anticipated service. To use a 3½% Ni steel in a 2¼% Ni steel application, or stainless in a 3½% Ni steel application, is basically an uneconomic practice. Note that T-1 is included in both the table and the chart to show its extremely high strength-to-price ratio, for applications where it can be considered at temperatures down to −50 F.

When a designer selects a suitable construction material, he is normally interested in the fabricability of his material. All of the steels described here, including T-1, have a long history of satisfactory experience in all normal fabricating operations. Except for some variation in the forming limits of the various steels due to physical properties, all are readily bent. Electrodes are available for welding all of these materials. It would be surprising to find unusual fabricating difficulties in the course of building a structure with any of these steels.

Here are several pointers for the engineer working on a low-temperature vessel or structure:

- Consider the ambient temperature. Experience has shown the materials discussed here to be tough and reliable within their applicable ranges.

For temperatures to −50F. consider:

A-201 or A-212 to A-300; or T-1

For temperatures to −75 F.

A-203 Gr. B to A-300

For temperatures to −150 F.

A-203 Gr. E or A-410 to A-300

For temperatures below −150 F.

A-353 to A-300 or
T-304 stainless steel or
Nonferrous materials such as aluminum, Everdur, etc.

- Try to specify material to existing standards and tests. Nonstandard tests sometimes generate much confusion.
- Never choose a material which can be used for lower temperatures than needed for the service under consideration—except for good reasons. As we have already seen, the lower the temperature for which the material is suited, the higher the cost in all the cases we have discussed.



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JOSEPH H. PROCTOR is manager of application engineering for Lukens Steel Co., Coatesville, Pa. He joined the company in 1949 and before assuming his present title last year, was engaged in various activities in design engineering, technical service and marketing service. His bachelor's in ME is from Drexel Institute. In World War II he served in the Army Signal Corps. At present he has memberships in ASME, API and in the Army Ordnance Association.

A great product.
Lots of ways to make it.
Which way is cheapest?
Now, from R & D data, you can

Estimate Manufacturing Costs

RICHARD M. BERRY, Lucidol Div., Wallace & Tiernan Inc., Buffalo, N. Y.

Estimation of manufacturing costs for a product while it is in the research and development stage can be difficult. This is particularly true when there are many process alternates, or alternate processes, or where the chemistry is complex.

Yet such estimates are necessary if we are to make meaningful decisions regarding the manufacture, or method of manufacture, of a new product. The problem is complicated when we cannot specify the equipment.

A simplified scheme for estimating the manufacturing cost of a chemical which does not involve capital has been found reasonably reliable and easy to use.

Two Components in Cost

Manufacturing cost of a chemical has two parts; the cost of the materials and the cost of converting them to the desired products, or conversion cost. We must estimate materials separately in the usual manner from laboratory, pilot plant, literature or patent data or by omphaloskepsis.

We present a theoretical derivation of an equation for finding conversion cost.

For any process

$$F = kK \qquad (1)$$

which is the commonly used relation that fixed costs are proportional to capital.[1]

Another equation

$$hC^n = K \qquad (2)$$

says that capital cost at a particular volume is related to some power of the capacity, often the 0.6 power.[2]

Substituting in Eq. 1 to eliminate capital, we get

$$F = khC^n \qquad (3)$$

Then, converting fixed cost ($/yr.) to unit cost ($/lb.), we get

$$F' = F/C = kh/C^{1-n} \qquad (4)$$

In the original expressions relating fixed cost and capital (Eq. 1) and capacity and capital (Eq. 2), the constants h and k represent complexity when the equations are applied to different processes. (Normally, when Eq. 2 serves as a capacity ratio on a single process, the constant is not present.)

Number of process steps is one measure of complexity which we can evaluate in early stages, often from the literature. We define a process step as a step which would appear in a block flow diagram of the process. Thus each reaction, purification, crystallization and drying, each major treatment of a feed or recycle stream is a process step. Minor operations, such as removal of solvent from a batch reaction or filtration to remove a small amount of solids would not be so considered.

Process steps are a particularly useful concept where there is a choice between process methods but no valid criteria for choosing a particular method. The concept is useful in evaluating alternate syntheses or proposed process simplifications to get an idea of the expected savings of one method over another.

We can obtain a practical expression if we rewrite the equation of similarity, changing the units for convenience:

$$G = gP/C^{1-n} \qquad (5)$$

which says that the unit cost is proportional to the process steps and inversely proportional to the capacity raised to a fractional power. This is in some ways an extension of the technique described by Wessel some time ago to estimate operating labor.[3]

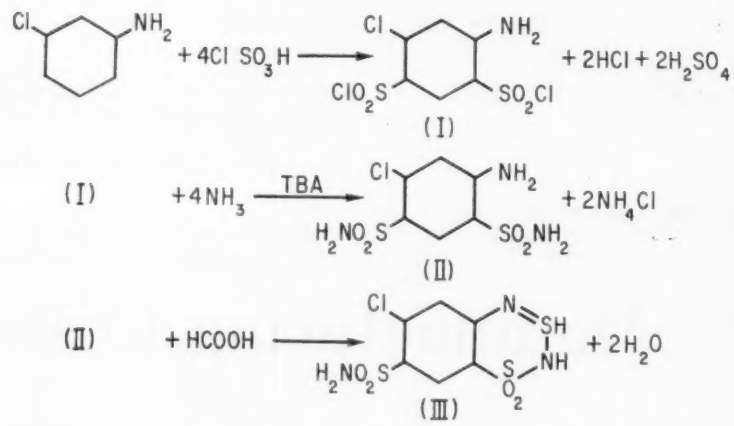
You can easily obtain empirical values for g and n (or 1-n directly) for a group of processes at various capacities. Correlation of the data should minimize the absolute difference between actual and calculated values.

When adding process steps together, the scale of product throughput must be roughly the same throughout the process. If production capacity is not within ± 30%, such as in separate manufacture of two intermediates that are combined into a final product, the sub products' costs must be calculated and a proportional part of that unit cost introduced accord-

Nomenclature

C	Capacity, lb./yr.
F	Fixed cost, $/yr.
F'	Unit fixed cost, $/lb.
G	Conversion cost, ¢/lb.
g	Empirical constant
h, k	Constants
K	Capital
n	Scaling factor, commonly 0.6
P	No. of process steps

Chemistry of Diuril Manufacture Is Complex—Fig. 1

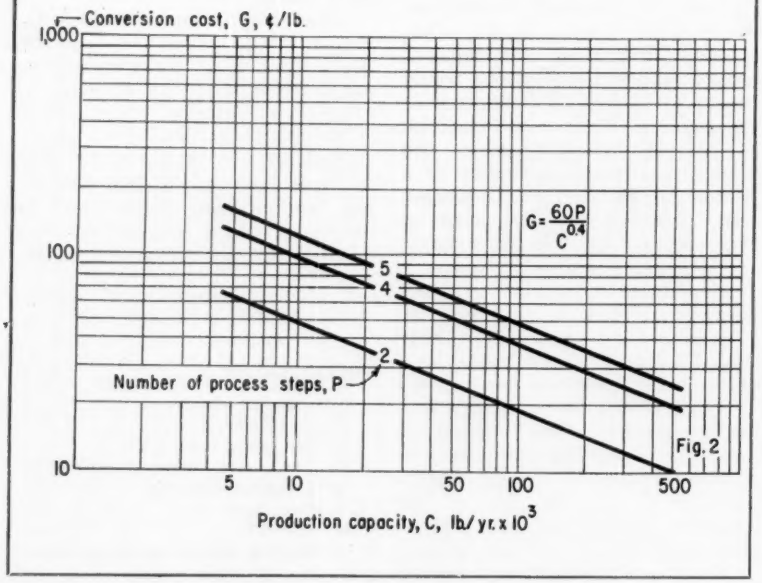


ing to the amount of intermediate used.

Conversion Cost Is Many Costs

Conversion cost is actually made up of fixed costs, variable costs, and utilities. For new facilities, most of the costs considered as variable in an operating unit are proportional to process complexity. So, for purposes of estimating, we may consider them as fixed costs. For some products, utilities should be estimated separately. But for many complex organics and pharmaceuticals, utilities are an almost fixed cost. Actually, we can challenge many items individually, but as long as consistent cost distribution factors are maintained in practice, the error will be small.

Number of Process Steps Is Parameter for Conversion Cost



Here Is an Example

To demonstrate this method, we have estimated the cost of making Diuril, a pharmaceutical made by Merck. A description of the chemistry and process for making Diuril can be found on pp. 60-63 of the Nov. 2, 1959 issue of *Chemical Engineering*.[4] Fig. 1 shows the chemistry of the process.

Table 1 shows the cost of materials, raw and process, that go into a pound of Diuril (100% active ingredient without compounding.) Costs of materials are from the 1959 fourth quarter report in *C & E News*[5] and assume purchase in carload quantities with 1¢/lb. freight. All costs are on a 100% basis. We assumed yields from reported literature data on similar compounds.

It is most probable that there are six process steps involved in the manufacture of Diuril but assuming a range of 6 to 7 is better. We calculate the conversion cost for Compound I (2 steps) separately because of a marked change in throughput.

We assigned values to g and $1\text{-}n$ in Eq. 5 and obtained

$$G = 60P/C^{0.4} \qquad (6)$$

which we will use to obtain the conversion cost.

Experience has shown that the exponent $1\text{-}n$ ranges between 0.3 and 0.55. The constant g ranges between 30 and 65 when capacity is in M lb./yr. and between 4 and 8 with capacity in MM lb./yr.

If we plot Eq. 6 on log paper, with number of process steps as a parameter, we obtain a graph relating conversion cost to capacity, Fig. 2, which consists of a series of straight lines with a slope of 0.4. The conversion cost figures entered in Table II were obtained from Fig. 2. A detailed breakdown of conversion cost is shown in Table III.

If we add selling costs, packaging and freight costs, research and development costs and general administrative expense, we can calculate the total cost of operation at a given sales level. If we then establish a minimum or desirable profit, we can calculate the selling price of the chemical.

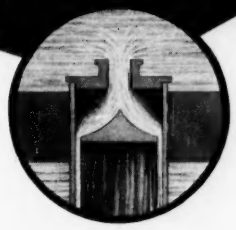
Keep It or Drop It?

If we maintain a range on all costs, as described by Gilfoil and

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Vogt





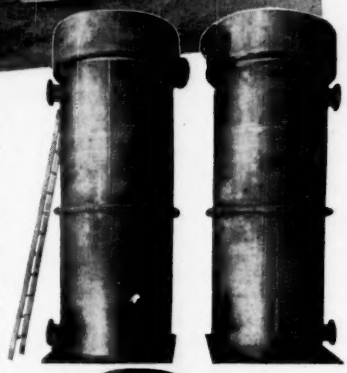
*One of the many distributor types developed for various applications.**

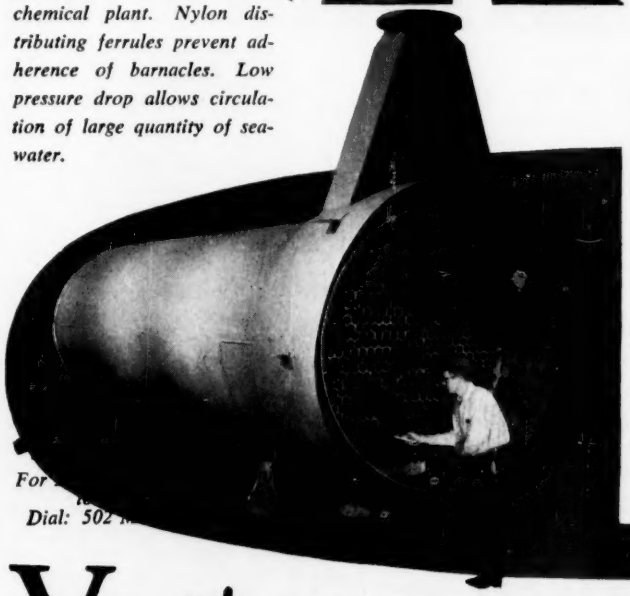
**Covered by Pat Nos. 2,057,597, 2,424,441 and others pending.*

TOP: *Muddy well water is the coolant for these Jacket Water Coolers.*

RIGHT: *Two 56" Dia. x 12'0" high Amine Solution Coolers with expansion joints in shell.*

BOTTOM: *One of a number of seawater cycle units for a chemical plant. Nylon distributing ferrules prevent adherence of barnacles. Low pressure drop allows circulation of large quantity of seawater.*





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Raw and Process Material Costs per Pound of Product—Table I

Chemical	Quantity or Yield	Lb./Lb. Diuril	Mat'l. ¢/Lb.	¢/Lb. Diuril
m-Chloroaniline	60–75% on cmpd. I	0.751–1.31	75.0	56.4–98.5
Chlorosulfonic acid	120% of theory	3.30 –5.77	4.7	15.5–27.1
Cmpd. I	85–95% on cmpd. II	1.44 –2.01		
Anhyd. ammonia	110% of theory	0.330– .462	4.6	1.5– 2.1
t-butyl alcohol	35% slurry-90% recovery	0.323– .428	16.0	5.2– 6.7
Cmpd. II	80–90% on cmpd. III	1.20 –1.51		
Formic acid	110% of theory	0.213– .267	19.1	4.1– 5.1
Hydrochloric acid		0.10	1.7	0.2
Caustic soda		0.10	3.9	0.4
Methanol		0.20	4.6	0.9
Finished Diuril	80–90% on crude III			84 –141

Material plus Conversion Costs Gives Total Cost—Table II

	Production Volume, Lb./Yr. 5M	10M	50M	100M	500M
Cmpd. I[a]					
Conversion cost, ¢/lb.	45– 54	36– 41	19– 22	14–16	7.5–8.6
Apportioned to Diuril					
From cmpd. I [b], ¢/lb.	65–109	52– 83	27– 43	21–33	11–17
Cmpd. II and III [c], ¢/lb.	130–158	95–119	50– 63	38–48	20–25
Total conversion cost, ¢/lb.	195–267	147–202	77–106	59–81	31–42

(a) 2 process steps.
(b) Product volume at 1.44 and 2.01 times Diuril production volume.
(c) 4–5 process steps.

How Conversion Costs Are Apportioned—Table III

	Product Volume, Lb./Yr. 5M	10M	50M	100M	500M
Conversion cost, $/lb.	1.95–2.67	1.47–2.02	0.77–1.06	0.59–0.81	0.31–0.42
Materials cost, $/lb.	0.84–1.41	0.84–1.41	0.84–1.41	0.84–1.41	0.84–1.41
Total mfg. cost $/lb.	2.79–4.08	2.31–3.43	1.61–2.47	1.43–2.22	1.15–1.83

Mongan,[6] we get a range of required product selling price which gives a good picture of its prospects as a new product when compared to the price the chemical may command in the market.

If the selling price the chemical can command is higher than the highest back calculated price, a full speed development program would be warranted. If the selling price that must be charged under the most optimistic processing conditions is greater than the market will bear, the project should be dropped. In the zone in between, continued development and new and firmer data are required.

This simple relationship between process steps and conversion cost has been found useful in early cost estimation before much process information is available and in situations where a number of similar process or chemical alternates exist; that is, any situation where evaluation of a number of alternates is needed to zero-in on those problems with practicable solutions.

The general applicability of a single set of constants over a wide range of process types has not been investigated. Such an equation would have little value in estimating very large production volume items where an assumption of 2 to 5¢/lb. conversion cost would not alter the economic prospects of the chemical. It is most useful in estimating smaller volume products with complex chemistry, these processes naturally having the greatest array of alternates.

Experience with several groups of products has shown that agreement of actual and calculated results within ± 15 or 20% is obtainable at production volumes of 5 to 10M lb./yr. or greater. Volumes lower than 5M lb./yr. have invariably shown the actual result to be lower than the calculated. This would be expected at some volume since there is a practical cost of producing a small amount of material where the formula shows no limit.

Substitute Volume for Capacity

Often, we can substitute production volume for capacity when analyzing an existing product. After we have determined the capacity exponent, we can predict the variation in conversion cost with production volume in a particular plant with the equation covering a particular group of processes.

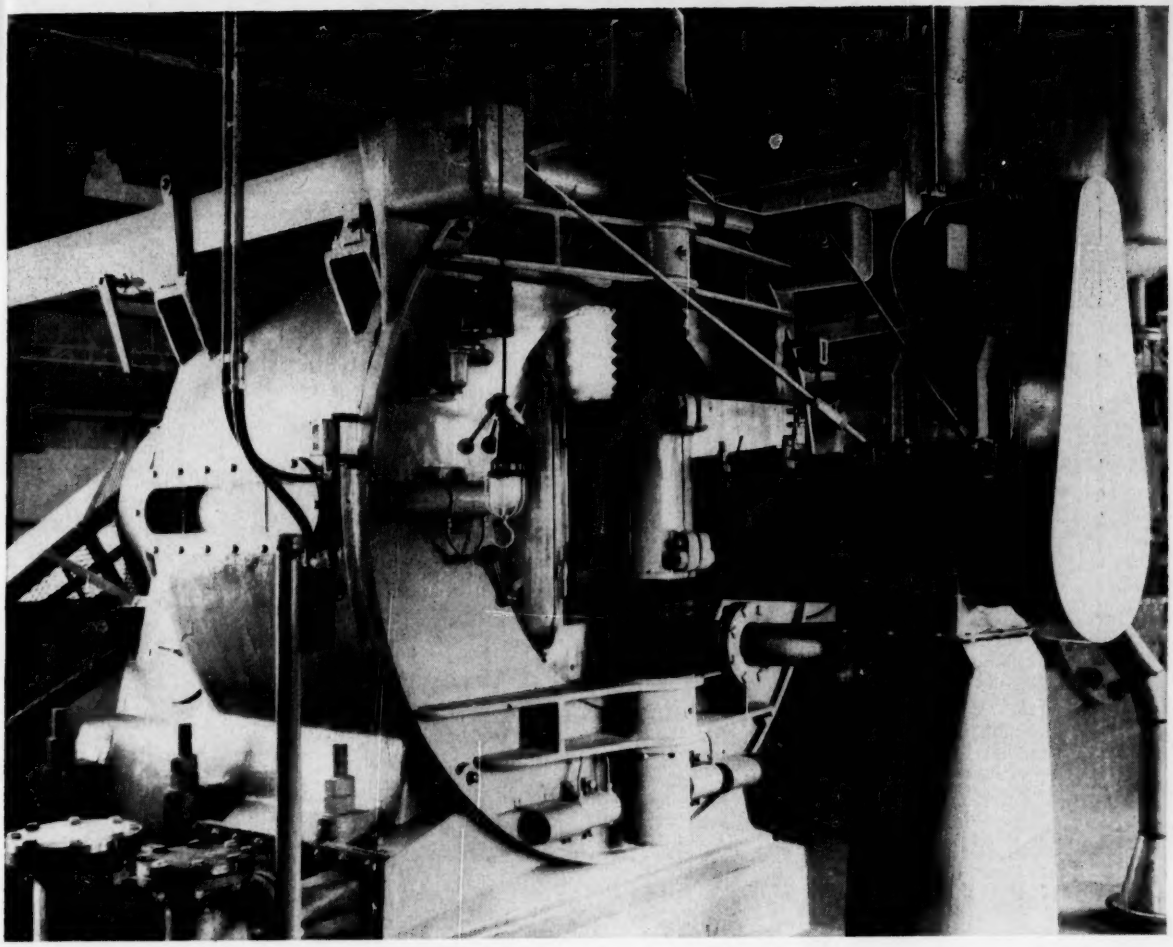
Actual cost reduction occurs in fits and starts where the equation predicts a smooth change, but agreement of actual and calculated results in such cases has been within ± 10 %.

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2. Williams, Roger Jr., *Chem. Eng.*, Dec. 1947, pp. 124-125.
3. Wessel, Henry E., *Chem. Eng.*, July 1952, pp. 209-210.
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5. Current Prices, *Chemical and Engineering News*, Dec. 28, 1959, p. 45.
6. Gilfoil and Mongan, "Process Evaluation," *Chem. Eng. Prog.* 54, 62 (March 1958).



RICHARD M. BERRY is the manager of Lucidol's Commercial Development Department at Buffalo, N. Y. He is responsible for market research, product development and economics. Previously, Mr. Berry was a chemical engineer with Shell Chemical Corp. in various positions in Denver and New York. He also served with the U. S. Army Chemical Corps at the Rocky Mountain Arsenal in Colorado. Mr. Berry graduated from Michigan College of Mining and Technology with a B. Ch. E. in 1950. He is a member of AIChE and ACS.



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In a recent article, describing a sister plant, the following statement was made:

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Full production was reached within three days from start-up in the new installation at Corn Products Company's Pekin, Illinois, Plant. Each of the 68" Automatic Reineveld Centrifuges handles about 1100 pounds of powdered corn starch every 7½ minutes. It dewaters a 22° Baume Starch Slurry containing 10-30 microns solids to an average moisture of only 33%. With material less difficult to dewater, this Reineveld could easily produce double this tonnage.

This highly efficient, space-saving installation operates completely automatic. The Reinevelds embody all the newest improvements and safety features, such as pneumatic locking devices, automatic brakes and thermo-couples on main bearings.

The patented bearing located at the center of gravity and other design features permit the Reinevelds to operate at higher G-forces, resulting in drier products even at exceptionally high tonnages.

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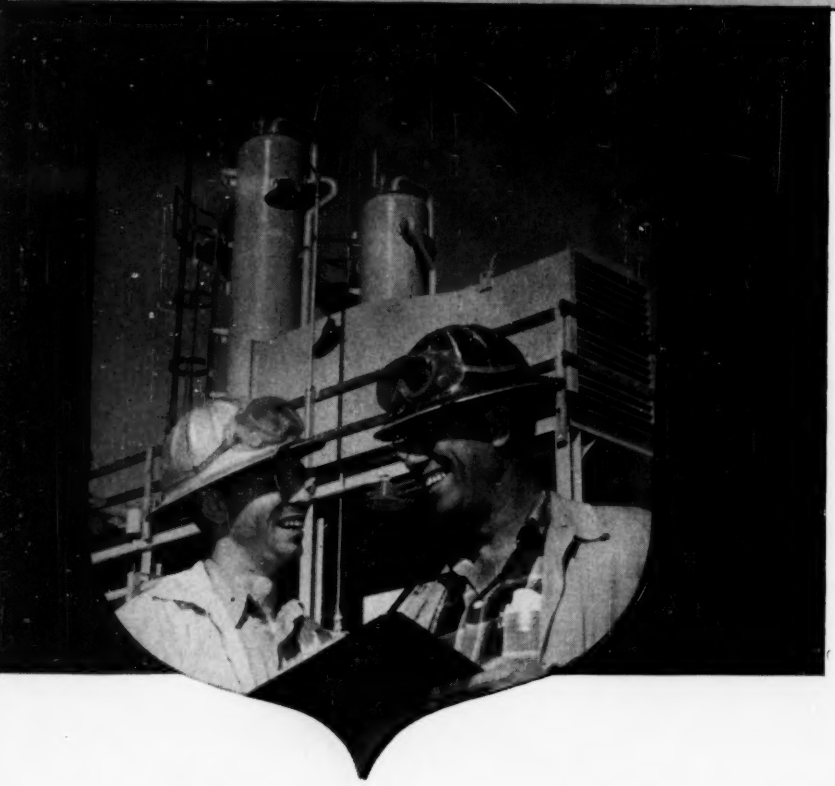
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Phillips Is Best Engineering Employer



First award for advancement, improvement, development and application of forward-looking engineering employment practices goes to the Phillips Petroleum Co.

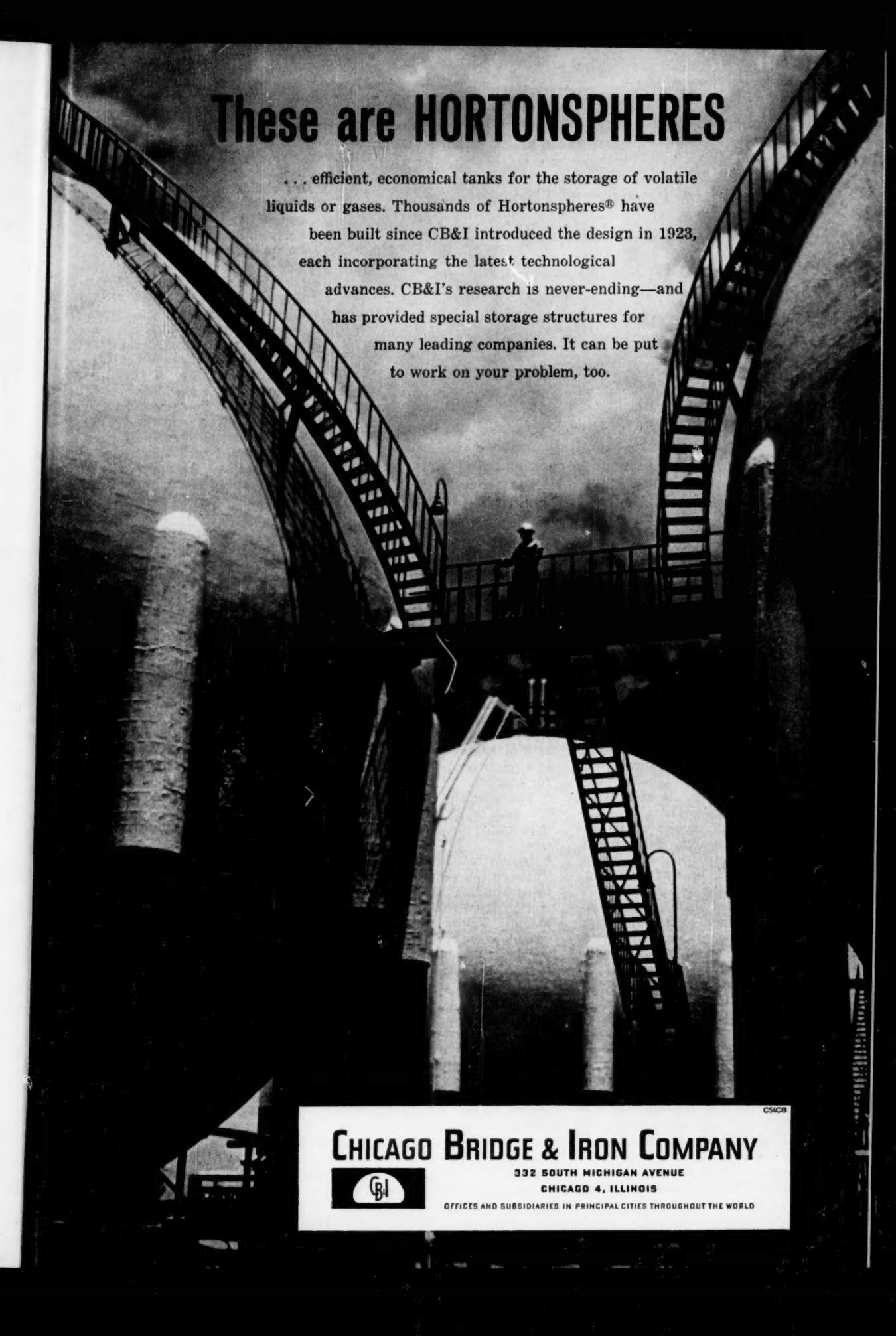
This month, at the annual meeting of the National Society of Professional Engineers (NSPE) in Boston, the Phillips Petroleum Co. of Bartlesville, Okla., received the first annual Industrial Professional Development Award.

When the award was established late last year (*Chem. Eng.*, Dec. 14, 1959, p. 184), *CE* assumed that the predominantly civil-engineering membership of NSPE would select an employer of civil engineers to be the first award winner. And since less than 4% of the 52,000 members of NSPE are chemical engineers, it would be extremely unlikely that a chemical or petroleum company would qualify as an award recipient.

We guessed wrong. As the table on the next page clearly shows, chemical engineers outnumber all other disciplines of engineering at Phillips Petroleum.

▶ **Why an Award?**—The NSPE award to Phillips recognizes "outstanding advancement and improvement in the development and application of forward-looking engineering employment practices."

Although there will be only one winning company each year, NSPE hopes that the existence of the award will encourage all


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Chemical Engineers Outnumber All Others at Phillips Petroleum

Degree	Number of Engineers
Chemical	788
Civil	249
Electrical	174
Mechanical	495
Petroleum	210
Others*	144

*Includes: Aeronautical, Agricultural, Architectural, Ceramic, Construction, General, Geological, Industrial, Metallurgical, Mining, Structural, Textile and Math & Physics Engineering.

industrial employers of engineers to adopt professional employment practices.

Here's a quick rundown on why the first award went to Phillips.

▶**Engineers Spark Growth** — Phillips' management is well aware of the significance of engineers in the continued growth of the company. It also recognizes the importance of engineers in all phases of its activities: research, development, design, construction, exploration, production, manufacturing, transportation and marketing.

In each of these principal activities, as well as the supporting ones—economics, employee relations, industrial relations, and others—competent engineers supervise and carry out major responsibilities.

The company encourages its engineers to support their profession, their community and society in general.

Phillips now employs 2,060 graduate engineers. Of these 53 hold two B. S. degrees, 145 hold M. S. degrees in engineering and 34 have earned doctorate degrees in engineering.

Average age of Phillips' engineers is 37 years. Average experience with the company is 11.2 years.

▶**Low Turnover Rate**—Phillips is proud that the vast majority of its engineers have obtained their entire technical experience with the company. The turnover rate of engineers and scientists is a relatively low 5.2% in 1959, for example.

The company attributes this low rate to its outstanding job opportunity and transfer policies.

▶**Promotion From Within** — Through the years the company has maintained a policy of promotion from within the organization. Engineers are given consideration for higher level supervisory and management positions in accordance with their demonstrated ability, efficiency and performance.

Only when a position is open requiring unique talents, which are not at the time available within the company, does Phillips seek candidates for engineering supervisory and managerial positions from outside the company. The present abilities and potentials of engineers are continually evaluated so that each person may be fully considered when upper-level positions open or new jobs are established. Phillips encourages on-the-job training and development at all levels.

As prime examples of the promotion-from-within policy, the president, chairman of the executive committee and asst. to the president, executive vice president, other vice presidents, chairman of the operating committee and many department managers are among the engineering graduates who came to Phillips directly from college.

Phillips employs a sufficient quantity of high-caliber engineers to meet the company's normal growth requirements. No attempt is made to hire all engineers needed for a particularly large, short-duration project with the thought of terminating those not needed at the completion of the project.

Rather, parts of such engineering projects are contracted to other engineering concerns. This policy has made it possible for Phillips to maintain a stable organization of qualified engineers with high morale and a desire to deliver peak performance.

▶**Lifelong Education**—Once an engineer starts at Phillips, his technical education does not cease. In fact, it's just begun.

Phillips employs many engineers and scientists who devote considerable time to educating other engineering and scientific employees. Recognized experts are engaged on a consulting basis to convey technical information to employees. Also, employees are urged to participate in technical courses offered by universities and colleges in the areas in which they are located.

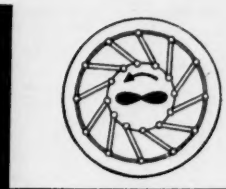
Many technical information programs given to employees are conducted at company expense and on company time. Planned job-rotation programs are used to broaden the base of the engineer's technical background and to broaden his perspective.

Newly employed engineers are often assigned to a formal training program. In some departments an informal training program is used.

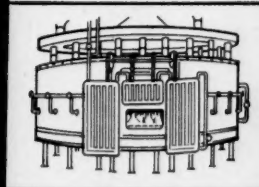
Engineering employees are encouraged to prepare technical papers and articles. Engineers now employed by Phillips have prepared over 1,300 technical ar-

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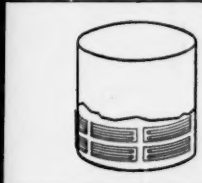
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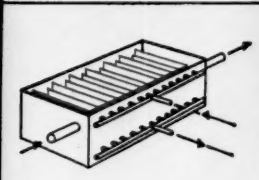
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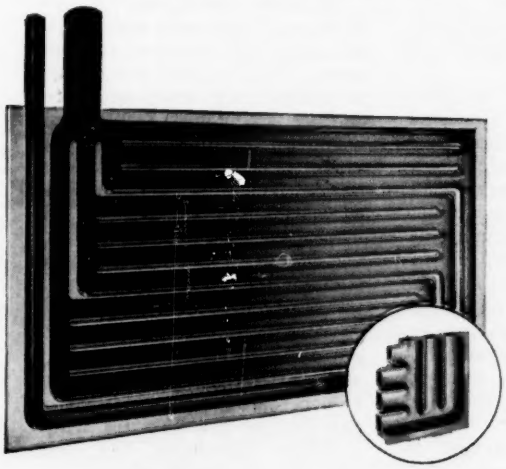
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Multiple headers with multiple condensate returns provide better steam distribution and more total effective heat transfer area in the new MULTI-ZONE PLATECOIL. FREE-FLO action, without condensate trapping increases processing production through faster "start-up" and extremely fast temperature recovery. This reserve capacity also holds temperature variations to a minimum. PLATECOIL eliminates problems of engineering, fabricating, installing and maintaining pipe coils. PLATECOIL units are lightweight and easy to handle. They are compact and save tank space. Deposits do not build up on streamlined PLATECOIL surfaces as they do on pipe coils. All stainless steel and alloy PLATECOIL units affected by cold working are annealed and pickled after fabrication to return the metal to its original condition and thus eliminate the probability of corrosion due to internal stresses and carbide precipitation. PLATECOIL is also relatively simple and economical to remove, clean and re-install. In most cases there is no need for threaded joints within the solution to corrode or leak.

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PAUL ENDACOTT, who rose from civil engineer to president, will accept the award for the Phillips Petroleum Co.

ticles for publication during recent years.

The company encourages its engineers to join technical societies and to participate in their activities. Local chapters of national societies have been organized through the efforts of Phillips engineers. Phillips engineers hold 886 memberships in 92 technical societies. Many of these memberships are maintained for the engineer by the company.

▶**Part of Management** — The company believes that engineers are part of the management team. Engineers are advised of those matters that will affect their current and future status as supervisors or managers.

Engineers participate in supervisory training programs. Also, the company is presenting to its technical employees a program in human relations. The program is now in its third consecutive year.

Engineers are encouraged to prepare themselves for administrative responsibilities through participation in a wide range of educational, social, fraternal and civic organizations. To encourage engineers to take advantage of administrative development opportunities the company recognizes engineers in accordance with their achievements.

This is done by increasing salaries, adding responsibilities and making promotions.

To allow engineers to make best use of their training and ability, Phillips provides them with draftsmen, technicians, clerks, stenographers and other nontechnical employees. The services of these supporting personnel free the technical employee for challenging, nonroutine, technical work and subsequent upgrading of job results.

▶**Professional Development** — The company sets the example for its engineers to think and perform professionally.

Engineers are encouraged to become registered under state registration laws. Since 1956, the company has paid all costs incurred by engineers in securing initial registrations, as well as for registration seals and renewal fees.

Phillips believes that engineers—as all its people—should be given individual consideration. Throughout his service with the company, each engineer is observed, evaluated, counseled and encouraged.

Throughout the company, proper use of engineering talent is practiced. Every effort is made to place engineers on technical and administrative work with nontechnical assistants performing the routine duties.

▶**Salary Policies**—Salary levels of engineers take into account continuous studies of data exchanged with competitive companies and industries. Due consideration is given to various reports and recommendations of professional engineering societies.

Particular attention is given to starting rates and the effect of changes on current salaries of present staff members. The company's salary plan provides for merit increases based on outstanding performance. In addition, special increases are granted to engineers when necessary to maintain salary differentials.

To demonstrate that engineers are considered as part of the management team, key engineers participate with management personnel in the company's stock option plan.

When engineers leave the company, exit interviews are used to get at the real causes of resignations. Phillips does not engage in "gentlemen's agreements" precluding change of employment without the consent of the previous employer. The company provides candid references and evaluations of prospective employees to other companies.

▶**A Good Example** — Although much of the above may sound as if its principal value is for recruiting engineers into an organization, other employers of engineers would be well-advised to consider the forward-looking employment practices for which Phillips Petroleum has been awarded the NSPE plaque.

And other engineering societies might well consider the advisability of recognizing the employers in their fields that pioneer in improving engineering employment conditions.

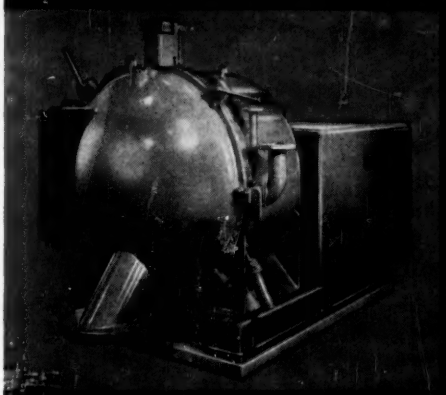
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BAKER PERKINS research now brings you the HS 40 W Universal Pressure Centrifugal, engineered for normal operation at 1000 times gravity and internal pressures to 150 psi. Several important features are entirely new: A MECHANICAL SELF-BALANCING SHAFT SEAL is positioned where the main shaft enters the housing and is the only major moving seal. A CLAMPING AND SELF-ALIGNING DOOR SEAL consisting of a floating ring plus two O-rings assures a completely safe lock without the necessity of tightening bolts. A SIMPLIFIED DESIGN OF THE DISCHARGE KNIFE AND CHUTE. Complete discharge of all solids is effected, eliminating swirling or dusting of solids within the housing. PROGRESSIVE PEELING. For the first time, provision is made for the peeler knife to enter the cake at successively increasing depths. Glazing of the heel is eliminated. Air displacement is controlled during both the charging and peeling operations.

As in all Baker Perkins Universal Centrifugals, the interior of the new model is completely and readily accessible. For complete specifications of the high capacity HS 40 W Universal Pressure Centrifugal, see your B-P sales representative or write to:



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CE COST FILE

No. 34: Labor Factors; Motor Starters

E. Wayne Michel, AACE, Baton Rouge, La.

The following tabulations give man-hours for mounting and connecting d.c. and wound rotor motor starters. Units include connections at motor and testing for direction of rotation but no wire or conduit. Based on experience in Gulf and West Coast areas, units represent work of an average journeyman.

Starters for Wound Rotor Motors

Dial-Type Speed Regulator Rheostat including line contactor

Maximum Rating 3-phase	Brick		Mounting Concrete		Steel	
	220 v.	440 v.	220 v.	440 v.	220 v.	440 v.
1 hp.....	8.1	8.1	9.6	9.6	9.9	9.9
3 hp.....	9.0	9.0	10.5	10.5	10.8	10.8
5 hp.....	9.9	9.9	11.5	11.5	11.8	11.8
10 hp.....	13.0	12.9	14.7	14.4	14.8	14.5
15 hp.....	14.8	14.4	16.3	15.9	15.0	16.0
20 hp.....	17.7	16.8	18.9	18.0	18.4	17.5
25 hp.....	19.9	18.7	21.0	19.8	20.2	18.9

Drum Switch, Resistors & Contactor (starting or speed regulating duty, nonreversing)

Maximum Rating 3-phase	Brick		Mounting Concrete		Steel	
	220 v.	440 v.	220 v.	440 v.	220 v.	440 v.
5 hp.....	23.5	23.5	27.7	27.7	26.7	26.7
10 hp.....	28.9	24.7	33.0	28.8	33.6	29.2
15 hp.....	35.7	26.7	39.3	31.9	39.9	32.7
20 hp.....	37.8	28.8	41.2	37.0	41.7	37.8
25 hp.....	40.0	35.7	43.0	39.4	43.5	39.7
30 hp.....	42.0	37.6	45.3	41.8	46.2	42.1
40 hp.....	44.2	39.6	50.5	44.1	50.8	44.5
50 hp.....	47.2	42.0	54.0	45.4	55.2	45.9
75 hp.....	63.7	44.5	71.2	51.7	63.7	50.7
100 hp.....	75.0	47.2	80.2	57.7	75.0	55.2
150 hp.....	87.0	63.7	93.0	67.5	82.5	64.5
200 hp.....	96.0	75.0	102.0	80.2	90.0	76.5

Note: For reversing starters, increase units 10%.

D. C. Motor Starters

Starting Rheostats for D.C. Motors

Maximum Rating	Brick		Mounting Concrete		Steel	
	115 v.	230 v.	115 v.	230 v.	115 v.	230 v.
1 hp.....	5.4	5.4	6.1	6.1	6.3	6.3
3 hp.....	6.0	6.0	6.7	6.7	6.9	6.9
5 hp.....	6.7	6.0	9.0	6.7	9.1	6.9
7½ hp.....	10.2	6.7	10.9	9.0	11.1	9.1
10 hp.....	10.9	8.2	11.8	9.1	12.0	9.3
15 hp.....	11.8	8.8	12.7	9.7	12.9	9.9
20 hp.....	12.7	9.9	14.2	10.8	14.4	10.9
25 hp.....	15.4	11.8	16.3	12.7	16.6	13.0
35 hp.....	....	13.0	....	14.1	....	14.4
40 hp.....	....	14.4	....	15.3	....	15.7
50 hp.....	....	16.5	....	17.5	....	18.0

Note: For speed regulator with shunt field weakening, add 0.75.

Speed Regulating Rheostats for D.C. Motors (control by resistance in armature circuit)

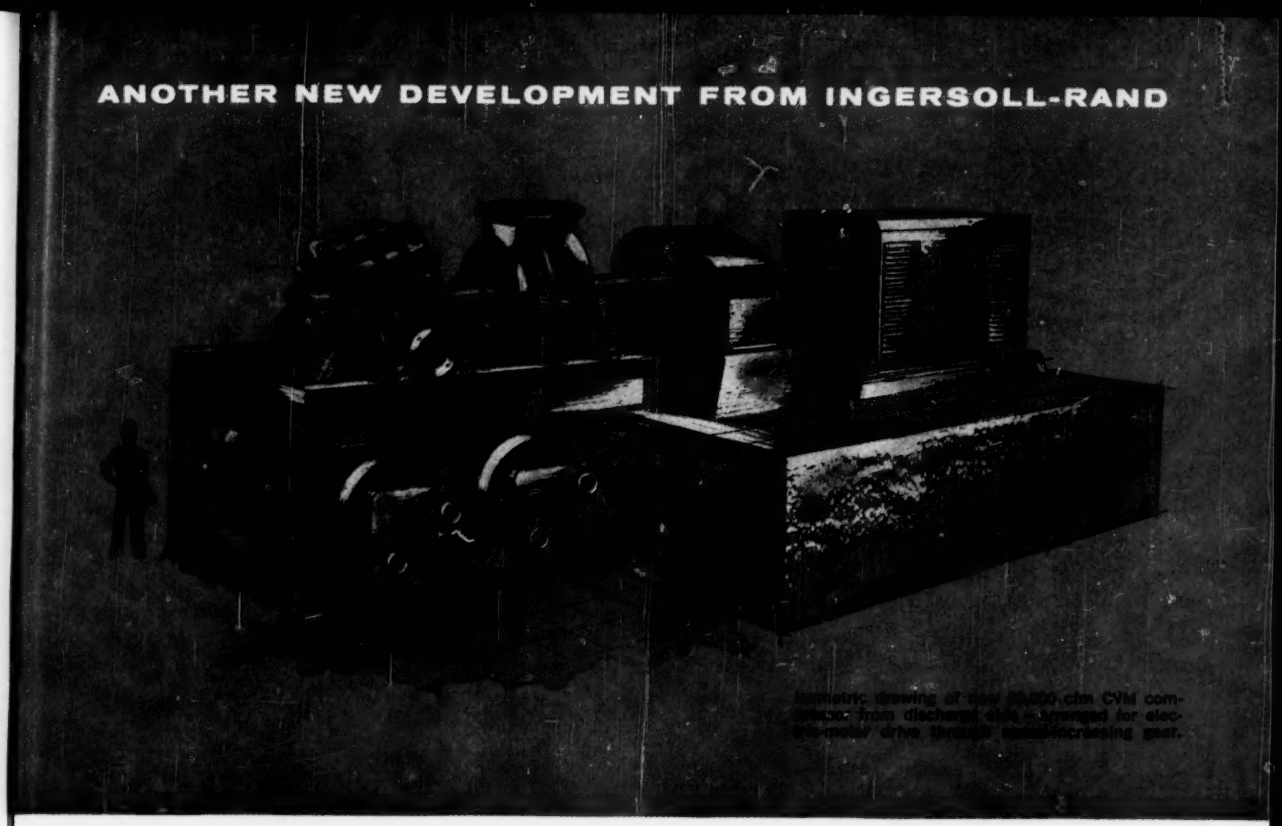
Maximum Rating	Brick		Mounting Concrete		Steel	
	115 v.	230 v.	115 v.	230 v.	115 v.	230 v.
1 hp.....	6.4	6.4	7.3	7.3	7.5	7.5
3 hp.....	7.5	7.5	8.2	8.2	8.4	8.4
5 hp.....	10.5	8.1	11.2	8.8	11.4	9.0
10 hp.....	12.1	9.1	12.9	9.9	13.0	10.0

Magnetic Starter for D.C. Motor (including push button)

Maximum Rating	Brick		Mounting Concrete		Steel	
	115 v.	230 v.	115 v.	230 v.	115 v.	230 v.
3 hp.....	10.5	10.5	11.2	11.2	11.4	11.4
5 hp.....	12.6	10.5	13.8	11.2	13.9	11.4
10 hp.....	13.6	12.6	15.1	13.8	15.3	13.9
15 hp.....	....	13.2	....	14.4	....	14.5

Note: For explosion-tested starters, increase units 15%.

ANOTHER NEW DEVELOPMENT FROM INGERSOLL-RAND

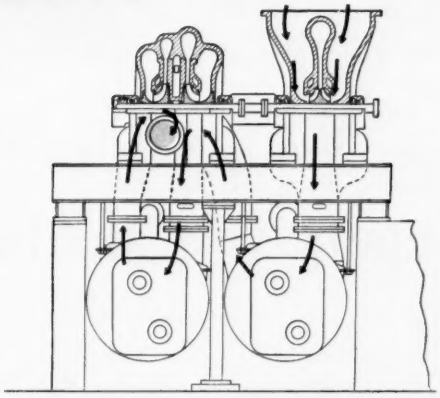


Isometric drawing of new 60,000 cfm CVM compressor from discharge side — arranged for electric-motor drive through speed-increasing gear.

NEW intercooled centrifugal compressor provides 100-125 psi air at capacities to 60,000 cfm

Ingersoll-Rand's new intercooled CVM centrifugal compressor is designed to provide high efficiency and low operating cost for 100-125 psi air at capacities from 30,000 to 60,000 cubic feet per minute. Utilizing the service-proved design principles of the 5-stage CVM compressor, introduced by Ingersoll-Rand last year for capacities to 35,000 cfm, the new unit extends the advantages of isothermal compression to *twice* the capacity heretofore available.

This new, larger unit features a double-suction first-stage impeller in a separate casing, with single-suction second and third stages in a second casing. Both casings are horizontally split for easy access, and each casing has a separate shaft. The use of separate casings and shafts permits most efficient aerodynamic design and enables both rotors to operate below first critical speed. Efficient water-cooled intercoolers suspended beneath the compressor remove heat of compression, approaching the ideal condition of isothermal operation and substantially reducing power requirements. Ask your Ingersoll-Rand engineer for complete information.

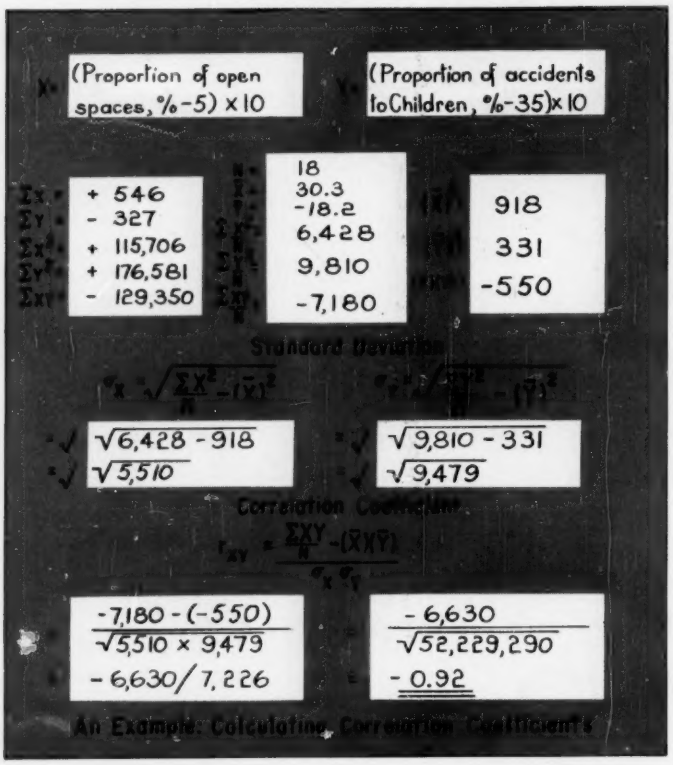


Side elevation with top half of casings cut away, showing air flow through compressor stages and intercoolers.

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THE WORLD'S MOST COMPREHENSIVE COMPRESSOR EXPERIENCE



Use Template to Speed Repetitive Calculations

System makes mistakes less likely and allows the job to be turned over to less skilled personnel.

C. F. A. Roberts
Orr's Zinc White Ltd., Widnes, Lancs., England.

When we need to work out routine mathematical calculations, it helps greatly to be able to use some method which will make the operation more mechanical. This makes mistakes less likely and simplifies the operation so it can be turned over to less skilled personnel. One such case is the Pearson's Square method which was described in *CE* by Fischer (p. 149, Sept. 8, 1958).

A method of general application for calculations of some complexity is to write the mathematical instructions—that is, the formulas into which to substitute—on a stencil or template similar to that shown here. Windows are cut out for entering the details onto a blank sheet of paper.

The diagram shows a template designed for calculating correlation coefficients. The calculations appear in the windows as if on a separate sheet of paper. The data used, taken from M. J. Moroney's "Facts and Figures," are quoted purely as an example.

Fluorescent Particles for Tracing Liquid Flow

Merton Allen
General Engineering Laboratory
General Electric Co.
Schenectady, N. Y.

Since the publication of my article, "Better Way to Trace Liquid Flow Patterns" (*CE*, p. 148, May 4, 1959), I have received many requests for details on adding fluorescent color to the particles used in the flow measurements.

There are three methods suitable for fluorescent-dyeing of plastic particles—two of which can be performed in the laboratory, and a third, spray drying, which requires extensive equipment as well as spray-drying technology know-how. The lab methods are as follows:

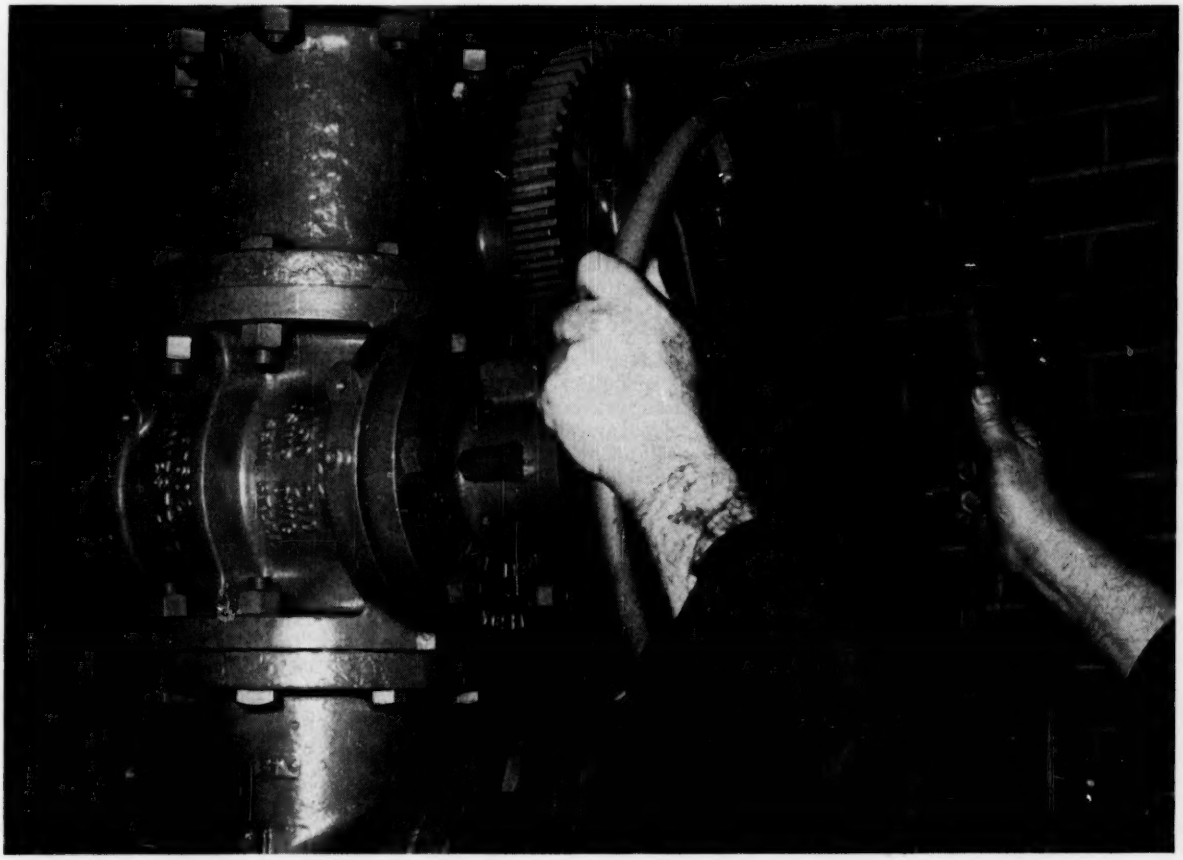
Mix-Coating

This method is best performed on small batches of plastic particles, 1 pint or less in volume.

Place the particles in a round, flat-bottom metal container (can, beaker, etc.) to a height of no

100% FLUID CONTROL AT YOUR FINGERTIPS

with Homestead Lubricated Plug Valves. When open, they provide full pipe-sized passage to fluids. Closed, their controlled high pressure lubricant



system, plus extremely close plug and body tolerance, guarantee a complete chemical seal—positive shut-off without contamination of line fluids. Instant response is sure, too, because piston-like movement of plug during each lubrication prevents sticking. They are low in first cost—low in upkeep. Write for complete details.

hv

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more than 3 in. Add enough lacquer to just wet all the plastic particles. The lacquer should consist of a different plastic dissolved in a solvent at 10-20% by weight.

Take care in choosing the lacquer so that it will not attack the plastic substrate or the pigment used—and so that it will itself not be attacked by the fluid whose flow properties are to be measured.

Introduce a mixer into the container, consisting of a turbine-blade mixing impeller on a vertical shaft, driven by a variable-speed transmission. The mixing blade should be 1 in. smaller in diameter than the container and should be ¼ to ½ in. above the container bottom. Mix the particles at 100-300 rpm. until the surface becomes tacky.

Now, add a fluorescent pigment, in quantity just in excess of what experience has shown is necessary to fully coat the particles. The pigment used by the author is Switzer Brothers Inc. Daylight Florescent Pigment (Day-Glo). It is available in many colors. Continue mixing until the pigment coats the particles and the particles are dry. Introduce air in a jet to blow away any excess of pigment.

As a protective overcoat, add the same lacquer in the same quantity and continue mixing until the particles are dry and have an agglomerated appearance. Hand-work the particles to break up the agglomerates to individual particles.

Chemical Fixation

This procedure can handle larger batches than the first, the only limitation being equipment size.

Suspend the particles in a liquid which will not attack them. Water is a good medium to use. Agitate the particles vigorously by whatever means is available.

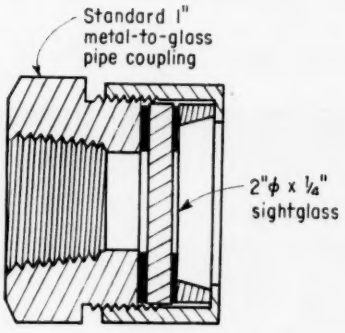
Now, slowly add a small quantity of a solvent which will vigorously attack the plastic particles, using vigorous agitation. This will render the particle surfaces soft and gummy. The attacking solvent may or may not be miscible with the suspending liquid. (For polystyrene, for example, the attacking solvent may be tricresyl phosphate, pyridine or acetone.)

As soon as a moderate amount of surface attack has occurred, add the pigment. The pigment particles will stick to the surface of the plastic particles as they collide in the vigorously agitated liquid medium. Then add a considerable quantity of a liquid which is miscible with the attacking solvent but which does not itself attack either plastic or pigment. Recover the particles by filtration, wash them with a nonsolvent and dry them.

A modification of the chemical fixation method is to dissolve the pigment in a liquid that will vigorously attack the plastic particles. This solution, containing a high concentration of pigment, is to be added quickly to a vigorously agitated water suspension of the particles to be colored.

Time is critical in this method. In a few seconds the solvent will attack the particle surfaces and will deposit pigment. A few seconds more will cause sticking and clumping. Before this occurs, proceed as above from the step where the attacking solvent is diluted with a miscible liquid to halt its attack, finishing the particles as before.

The fluorescent colored particles can be processed for size and density by methods described in the author's earlier articles, *CE*, Sept. 22, 1958, p. 176, (screening) and Dec. 15, 1958, p. 182, (density selection).



"Quickie" Sightglass for Pilot Plant Reactor

Robert E. Leonard
Senior Research Chemist
American Potash & Chemical Co.
Henderson, Nev.

In pilot plant work it often happens that some unanticipated item is needed in a hurry. For example, needing to examine the interior of a small reactor, we found that a standard 2-in. diam. x ¼ in. thick sightglass would fit into the 1-in. Fischer & Porter metal-to-glass pipe couplings used in the plant.

The assembly is attached to the reactor with a 1-in. close nipple. This may seem a small glass, but it provides ample area for examination of the vessel surface, particularly if a short-focus telescope is used for viewing the vessel interior.

Coming July 25: "Hypodermic Still" for Equilibrium Data

By Paul J. Horvath, Winner of the May Co[illegible]

★ How Readers Can Win

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebooks. Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

Progress Report... Primary amyl alcohol

A new alcohol with great reactivity

Do you have a five-carbon alcohol problem? If so, you may find your solution in CARBIDE's highly reactive mixed isomer, primary amyl alcohol.

CARBIDE's primary amyl alcohol consists of approximately 60% pentanol-1, 35% 2-methyl butanol-1 and 5% 3-methyl butanol-1. There are no lower molecular weight molecules, no residual chlorine, and no secondary or tertiary alcohols. That's why it is so ideal where lower volatility, greater reactivity, and increased efficiency are needed.

Primary amyl alcohol is useful as an intermediate for ore flotation reagents, plasticizers, di-ester-type lubricants, fuel and lube oil additives, resin catalysts, vinyl stabilizers, corrosion inhibitors, and surface-active agents. It can be the reaction solvent in preparation of penicillin salts, and a wash in their purification. This mixed isomer also is used as a coupler and latent solvent for nitrocellulose lacquers.

In contrast to secondary alcohols, primary amyl alcohol reacts readily with carbon disulfide and sodium or potassium hydroxide to form primary amyl xanthate . . . a powerful collector for concentrating sulfide minerals containing lead, nickel, zinc, iron, and copper.

Primary amyl nitrate prepared from primary amyl alcohol is an effective cetane improver for low cetane number distillates used as diesel fuels. It can be used to make zinc dialkyl dithiophosphates that provide corrosion resistance and antioxidant qualities for crankcase oils and transmission fluids. In heating oils, as little as 0.10 per cent primary amyl alcohol reduces burner maintenance by controlling sludge formation.



Ester-type plasticizers for vinyl chloride resins can be prepared with primary amyl alcohol. It can also be used to produce diamyl phthalate or, with higher molecular weight alcohols, to prepare mixed alcohol phthalate plasticizers.

The potential uses of primary amyl alcohol are many. For example—it deserves study for use in preparing esters of 2,4-D and 2,4,5-T herbicides, and as a spreading agent for oil-emulsion insecticides. Oil-soluble primary amyl phosphates and phosphites derived from primary amyl alcohol should be evaluated as catalysts in resin manufacture. Amines prepared from primary amyl alcohol are corrosion inhibitors, rubbers, agricultural chemicals, and surface-active agents. *And*, various esters of primary amyl alcohol lend themselves to use in perfumes and flavors.

CARBIDE's primary amyl alcohol is immediately available in tank cars or trucks, and in 55-gallon drums (carload or LCL lots). For more information, check the coupon for Technical Information Bulletin F-8517C.

Tear out this coupon. Check the boxes on which you'd like more information, and mail to **Dept. HE**, Union Carbide Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

☐ Primary amyl alcohol. F-8517C

☐ 1960 Physical Properties of Synthetic Organic Chemicals—a comprehensive description of the properties and applications of more than 400 CARBIDE chemicals.

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PROPERTIES . . .

Purity, as Primary Amyl Alcohol, wt. %	98.0 min.
Acidity, as Acetic Acid, wt. %	0.01 max.
Carbonyl, as C_5 aldehyde, wt. %	0.20 max.
Water, wt. %	0.3 max.
Apparent Specific Gravity, 20/20°C.	0.8134
Boiling Point, °C.	
760 mm. Hg	133.1
Freezing Point, °C.	−90 (sets to glass)
Solubility in Water at 20°C., wt. %	1.7
Solubility of Water in at 20°C., wt. %	9.2
Viscosity, cps.	
0°C.	8.5
20°C.	4.3
40°C.	2.4

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DIVISION OF
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- Prevent stockouts.
- Reduce inflated inventories.
- Cut high carrying costs.
- Try a machine calculator for

Scientific Inventory Control

John W. Mayer and Paul Taylor, Chemstrand Corp., Decatur, Ala.

Everyone is familiar with those two headaches of inventory control—overstocking and understocking. The first results in high inventory costs; the second can cause annoying, sometimes expensive shortages at critical times.

Many schemes have been devised to cope with this problem—some good, some indifferent, some worthless. We at Chemstrand have devised one which we call the Scientific Inventory Control Method which works pretty well for us and should work for you, too. It is merely a statistical approach to inventory control which makes use of the versatility and speed of a computer for its effectiveness.

You don't need a big, expensive computer either. We made do with a standard piece of accounting machinery, an IBM 604 calculator, even though an electronic computer was available to us.

So what is Scientific Inventory Control? It is a method by which we can balance reorder quantities and frequency against usage to obtain an optimum inventory cost. It requires calculation of two quantities—economic order quantity and reorder point.

We can determine the first of these quantities, economic order quantity or the number of units to order, by balancing the incremental cost of placing an order against inventory carrying charges. Cost of placing an order would consist of such things as paper, postage and typewriter ribbon. Inventory carrying charges would include taxes, insurance and building maintenance.

Calculation of reorder point is somewhat more difficult. It requires the application of statistical methods to past usage data to determine a minimum inventory level that will prevent stockouts.

▶ **Consider Some Examples** — Figs. 1 through 3 illustrate graphically some inventory problems. Fig. 1, for example, shows an ideal situation where the rate of usage is absolutely uniform as is also the reorder leadtime. Thus the storekeeper can confidently order his 35 units at regular intervals, allowing for the time necessary to process the orders and receive delivery, and be sure that the material will be in the storeroom before the stock drops to zero. Unfortunately, such an ideal situation never happens.

Fig. 2 shows what might happen if we tried to operate in the manner shown in Fig. 1, that is, establish the reorder point at the exact amount of material that would be used during the lead time. If the order were delayed for any reason, we would run out before the new order arrived. Or the same thing could happen if usage increased for any reason. In fact, an analysis of the situation shows that we have a 50-50 chance of running out every time we reach the reorder point and place a new order. This would tend to make the storekeeper unpopular.

To reduce the number of stockouts to a tolerable level, the storekeeper will add a safety stock for contingencies. We show this in Fig. 3. Here you will notice that the average inventory is now the sum of the average working inventory, or half the order quantity, plus safety stock.

Now let us consider a method for determining order quantity in such a way that we can operate the storeroom most economically.

▶ **Find the Minimum Cost**—In Fig. 4 we have plotted the cost of maintaining an item in stores against the number of orders per unit time.

First, consider that we have placed an absurdly large order—enough material to last ten years. The number of withdrawals per year would be small, about one tenth, and the inventory would be large. Inventory carrying



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Get engineering assistance on any of your filtration problems from your Durco-Enzinger representative. A complete listing of Durco filtration equipment is available in Bulletin EF/2a.

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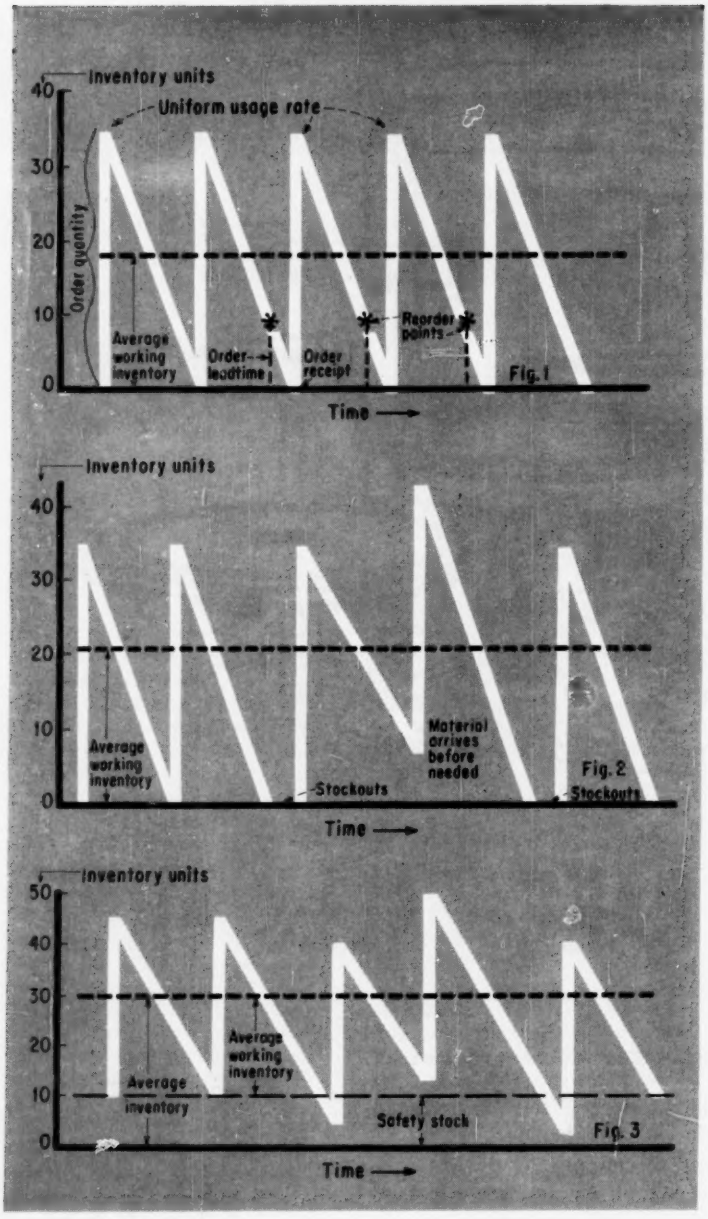
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Nontypical Charts Show Typical Situations



costs would be high but the ordering cost would be very low since we would order only once in ten years. This situation is shown on the left side of the plot. The total cost of maintaining this item in stores is high as shown by the top curve.

On the other hand, say we were going to order only a week's supply at a time so that we would have to order 52 times a year. In this case, the average inventory at any time would be low as would be the inventory carrying costs. But, since we are placing 52 orders a year, the cost of placing these orders would be high. As the top curve on the right hand side of the plot shows, we would be no better off than in the first case.

In between these two extremes there lies an optimum point where the sum of the two costs is a minimum. This is the point at which we would like to operate.

▶**Can We Calculate It?** — We can determine the optimum point, whose coordinates are order frequency and inventory cost, if we can find the optimum order size and reorder point.

We can derive an equation[1] for the optimum order size (or economic order quantity) Q, in dollars, as follows:

$$Q = \sqrt{\frac{2AB}{I}} \qquad (1)$$

In Eq. 1, I is the inventory carrying charge expressed as a percentage and A and B are constants for a given plant. For our plant B was \$7.90 per order and I was 18%/yr. So, for our plant, Eq. 1 became $Q = 9.35\sqrt{A}$ where A is the annual usage in dollars.

Now that we have a method whereby we can calculate the amount of material to order, we must find a way to determine scientifically the reorder point. This requires an intensive study of the frequency with which items were issued from stores for a considerable period into the past. In our case, we kept records of number of issues and number of items per issue for eighty months. Plotting this data results in a Poisson distribution from which we can establish a reorder point such that the probability of a stockout will be fairly low.

▶**Make Some Assumptions** — Assume that out of every eighty orders we place we can accept the possibility of running out three times before the orders are received. Thus the probability of a stockout is 3/80. Let's also assume that the average number of units per issue is always two and that the order lead time is always one month.

Now we can see that if we place our order point at four issues (eight items) we will be able to handle all requests for

COPPUS | BLUE RIBBON PRODUCTS



Coppus Horizontal Steam Turbine

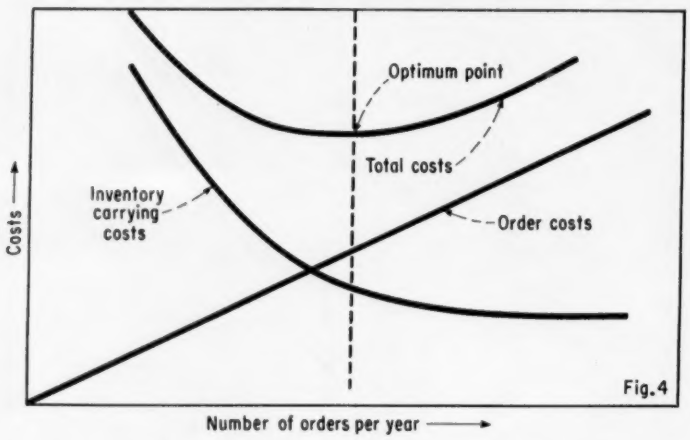
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Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

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COPPUS
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As Storage Costs Decrease, Order Costs Increase



months where the issues were one, two, three or four per month. Or, to put it another way, we can handle all the issues requested 77/80's of the times when material is on order.

Though this procedure is elementary and makes some nonvalid assumptions such as unvarying numbers per issue and no variation in lead time, it does give you some idea of the statistical basis for the reorder point. But the same statistical approach can find the average number of units per issue and average leadtime per order.

▶**Safety Stock** — Earlier we mentioned that the storekeeper will carry a safety stock to prevent stockouts between reorder and receipt of the orders. But this safety stock was based on a uniform rate of usage and is not really valid, so we must have a way for determining safety stock based on average number of units per issue and average lead time. A formula has been developed to solve this problem: safety stock equals P times the square root of average number of units issued per month. The factor P is related to the number of orders per year and can be found from the chart in Fig. 5.

▶**Reduce to Practice** — Now, since the reorder point is equal to the safety stock plus the quantity of material consumed during order lead time, we can easily calculate the economic recorder point from the data at hand. These data, of course, are based on records kept over a long period of time and reflect real conditions rather than the ideal situations mentioned earlier.

Fig. 6 shows a manual worksheet in which we have entered all the raw data from our records (columns A through E) and also entered the results of various simple arithmetical calculations based on these data (columns F through U). The column heads are self-explanatory.

Note that we not only determined our economic order quantity and reorder point, but also found that we could reduce the average inventory from thirty to twenty three units. This, of course, saves money.

While hand calculation of the optimum inventory might do very well in a small storeroom carrying few items, it is prohibitive for the typical plant. So the next step is to program these data and calculations into appropriate IBM machinery.

▶**Computer Operation** — The Management Systems Group in our plant, working with Machine Accounting personnel, used an IBM 604 calculator on this problem. By today's standards the 604 is a relatively simple piece of accounting machinery which means that you should not rule out machine calculation if you do not have access to a sophisticated electronic computer.

There is not space here to give a detailed account of programming the computer, but we can outline a few of the steps we went through to obtain the same results shown in Fig. 6 for the entire stores system.

Data fed to the machine (input) was the same as columns A through E in Fig. 6. Columns F through U correspond to the calculated values obtained from the machine. Since the entire program could not be completed in one pass through the 604, some of the calculated values in the earlier passes became inputs on the later passes. In point of fact, it required four passes through the machine to yield all the desired information.

Stores issue IBM cards for the previous 12 mos. were the starting point. These cards provided the item symbol number and annual usage figures.

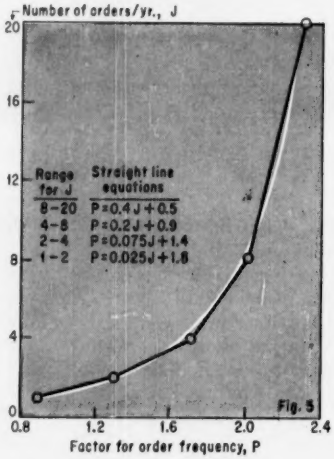
Stores personnel furnished lagtime information from the card files maintained for inventory control and usage history.

Unit cost for each item came from the Stores IBM master cards in Machine Accounting.

On hand quantity, not used in the initial program but necessary later, also came from the Stores card files.

Some items, such as spare parts for critical equipment, presented a problem because there was no regular usage. To do any of the calculations this information must be used, but a zero value for annual usage would give meaningless results. So we

P Determines Safety Stock



5A3-32 STORES SCIENTIFIC INVENTORY CONTROL CALCULATIONS Date _____

Basic Data from Records

*NOTE: When I is larger than A, set I=A and use this value for I.

	A	B	C	D	E	F	G	H	*I	*J	K	L	M	N	O	P	Q	*R	S	T	U
Stores Symbol Number	Annual Usage, Units	Unit Cost, $	Longest Normal Lag Time, Months	Ave. Units per Issue, Last 10 Months, Units	Ave. Inventory, Last 10 Months, Units	Annual Usage, $ A x B	$\sqrt{A \times B}$	Economic Order Quantity, $ G x 9.35	Economic Order Quantity, Units H ÷ B	No. of Orders per Year, A ÷ I	Factor for Order Frequency, P	Ave. Monthly Usage, Units, A ÷ 12	L x D	$\sqrt{L \times D}$	Safety Stock, Units K x N	Lag Time Usage, Units C x L	Reorder Point, Units O + P	Working Inventory, Units I ÷ 2	Predicted Ave. Inventory, Units, O + R	Inventory Reduction, Units, E - S	Inventory Reduction, $ T x B
17-10000	120	$10	1.0	3	30	$1200	34.7	$325	33	3.64	1.02	10	30	5.5	6	12	18	17	23	7	$70

WORK SHEET contains raw inventory data in columns A through E, calculated data in columns F through U.

inserted a value of 1 into the calculation and put an indicator on the final tabulation.

▶**A 20% Dividend**—We set out to find the optimum order size and order frequency. When we found these, we also found that we could anticipate a greater than 20% reduction in inventory levels. This, of course, meant a significant reduction in inventory carrying costs.

The next question then was "When we adopt this system, how long will it take us to get down to the lower inventory levels?" Again, this was a problem for the calculator because it involved simple repetition.

From average usage we determined cumulative usage quantities for periods up to three years and successively deducted these quantities from the corresponding balances on hand to find the balance for each time period.

The equation we used for this portion of our study was:

$$I = u + (d - nl)$$

Where I = Inventory, $
u = Predicted average inventory, $
n = Number of months
l = Monthly usage, $
d = Quantity to be attrited, on hand quantity minus u

This equation was also set up for the IBM 604 calculator and run through in two passes. The second pass yielded figures for inventory up to 36 months into the future.

▶**How it Works**—At our plant, results of the calculated data indicated that stores inventories could be reduced 22% and maintained at this lower level with scientific inventory control methods. Furthermore, we found that about 5% of the inventory consisted of items in excess of three years' supply. Chemstrand found it economically feasible to sell this excess as surplus rather than keep the items at carrying cost of 18% of inventory value per year.

We emphasize that this study was possible only with machine calculating equipment because the numbers of calculations were beyond the scope of manual methods. The fact that we used a fairly common piece of accounting machinery should be particularly interesting to companies that do not have access to electronic computers or the more sophisticated machinery usually associated with operations research.

REFERENCES

1. Welch, W. Everet, "Tested Scientific Inventory Control," Management Publishing Corp., Greenwich, Conn.



JOHN W. MAYER is a senior systems analyst in the Management Systems Dept. of Chemstrand Corp. He is assigned to the Data Processing Area. A native of West Pittston, Pa., Mr. Mayer attended Susquehanna University from which he received his B.A. in Mathematics and Physics in 1942. His previous experience includes five years as radar design engineer, teacher, statistician and supervisory computer programmer.



PAUL TAYLOR is maintenance superintendent for the Area Engineering and Maintenance Section of Chemstrand's acrylic fiber plant at Decatur, Ala. Mr. Taylor is a native of Huntsville, Ala., and attended the University of North Dakota and Georgia Tech from which he received his B.Ch.E. in 1949. Before joining Chemstrand, he had five years experience as instrument engineer with Du Pont and Union Bag & Paper Corp.

CORROSION-CONTROL DESIGN 4b

Part of a series appearing throughout 1960

Second of two articles on valve design

Valves for Severe Corrosive Service

These proved valve designs, developed after much trial and error, are ideally suited for severe corrosive service. The latest thinking on everything from globe to needle valves.

E. G. Holmberg, International Nickel Co., New York, N. Y.*

Valve manufacturers now know, after many years of trial and error, what features valves should have for corrosive service. Some of these design principles were discussed in our first article (*Chem. Eng.*, June 13, 1960, p. 238.)

Many new valves have developed from these concepts to satisfy specific processing requirements. We are going to discuss these special valves, designed for severely corrosive situations.

▶**Gate Valves**—Fig. 1a shows a gate valve with design features essential to good service life. It has (1) flanged ends, (2) bolted flanged bonnet, (3) integral seats and (4) outside screw and yoke.

Whenever design limitations permit, flange joints are preferred. Screw joints are a potential source for leaks—local cell action develops in the crevices formed after the joint is made. Thread lubricants resistant to the corrosive, that harden after setting, are of great assistance in overcoming this action.

Valves of the inside screw design, in which the stem is threaded into the disk, are undesirable because of selective attack in the threaded areas, resulting in excessive clearance. Outside-screw-and-yoke construction allows the stem threads to operate outside the corrosive environment and also makes them easy to lubricate.

▶**Long Bonnet**—The extended-bonnet gate valve (Fig. 1b) is designed to handle liquefied gases at subzero temperatures. Heavy insulation is required in such service, particularly on the body and bonnet. The extended bonnet makes it easy to get at the valve operating mechanism after insulation is applied. Design is also available in globe valves.

▶**Jacketed Valves**—Many liquids processed in the chemical industry must be heated to maintain fluidity. To satisfy this requirement the jacketed valve (Fig. 1c) was developed. Valves of this design are available in both gate and globe types. The built-in jacket provides an even distribution of heat to virtually all internal surfaces which the fluid contacts. To accommodate the jacket, the end flange and face-to-face dimensions of these valves are one size larger than the normal valve size.

▶**Globe Valves**—A globe valve equipped with a special disk will permit use of a soft corrosion-resistant material for the disk seating surface (Fig. 1d).

* For author biography, see *Chem. Eng.*, June 13, p. 242.

1. Plant Site, Layout Minimize Corrosion, Jan. 11, 1960, p. 144.
2. Proper Design Voids Equipment Corrosion, Feb. 22, 1960, p. 162.
3a. Often Overlooked Reactor Design Factors, May 2, 1960, p. 150.
3b. Keys to Corrosion-Wise Reactor Design, May 16, 1960, p. 170.
4a. Valve Design: Special for Corrosives, June 13, 1960, p. 238.

. . . Future Articles

Design of heat exchangers to minimize corrosion.
Storage tank design.
Design of mixers to minimize corrosion.



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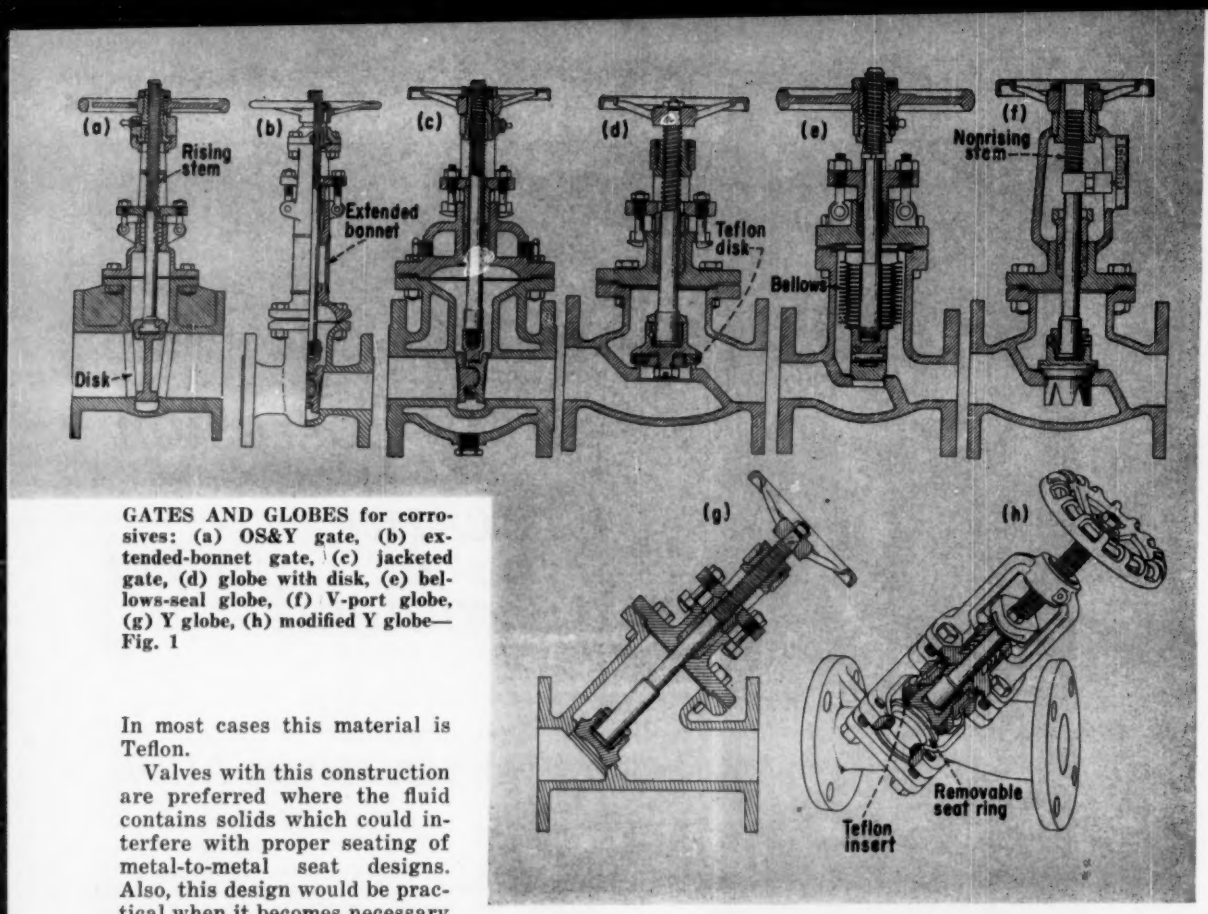
Send for test samples—Let us help you. Just write us a letter telling as much as possible about the corrosive conditions involved. If you would like more information about the properties and corrosion resistance of HASTELLOY alloy F, ask for a copy of our 12-page booklet. Address inquiries to Haynes Stellite Company, 270 Park Avenue, New York 17, N. Y.

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GATES AND GLOBES for corrosives: (a) OS&Y gate, (b) extended-bonnet gate, (c) jacketed gate, (d) globe with disk, (e) bellows-seal globe, (f) V-port globe, (g) Y globe, (h) modified Y globe—Fig. 1

In most cases this material is Teflon.

Valves with this construction are preferred where the fluid contains solids which could interfere with proper seating of metal-to-metal seat designs. Also, this design would be practical when it becomes necessary to use an alloy for the body which does not have maximum corrosion resistance. Some etching of the body seating surface will still permit a complete shut-off. The etched surface will simply result in a slight deformation in the disk seat that will not impair closure efficiency.

The globe valve shown is designed with a rotating stem and swivel disk. This combination is particularly desirable when a metal disk is used. It will prevent scoring and galling of the seating surfaces by a sliding movement of the disk during closure.

► **Bellows-Seal** — The bellows-seal (Fig. 1e) is frequently used when it's necessary to completely confine a particularly dangerous fluid within the valve recesses.

This construction will avoid the possibility of leakage to the atmosphere, which frequently occurs with conventional stem packing. Valves of this design have broad application in piping systems conveying fluids containing radioactive elements. Note the nonrotating rising stem.

► **V-Port Globe**—In a number of chemical operations it's necessary to maintain closer flow control than is possible with the usual globe valves. This has led to development of the V-port globe-valve design (Fig. 1f).

Valves of this type are also available with a parabolic disk.

As shown, a nonrotating rising stem is used and the disk is pinned to the stem to prevent rotation when in the throttling position. These valves are equipped with a stem indicator which permits returning to a previous setting.

► **Y Globe**—Y valves are particularly useful in some chemical processing operations when characteristics of both globe and gate valves are desired. Fig. 1g shows a standard version of this design equipped with a metal disk. Throttling these valves will give flow control and when in the wide-open position they offer a slightly greater resistance to flow than a gate valve. Valves of this design can be equipped with the same disk construction shown in Fig. 1d.

► **Modified "Y"**—A modification of the standard Y valve is shown in Fig. 1h. This is designed with a removable seat ring in the body and Teflon seat insert in the stem disk. The removable seat ring permits using various alloys for this part. The flange at the disk location permits rotating the lower half of the valve 180° to make a 90° angle valve, should it be required in a piping layout.

► **Plug Cocks** — Conventional plug cocks using a metal-to-metal seal between the plug and body have not been entirely satisfactory when handling some corrosive fluids.

Corrosion of the sealing surfaces under these conditions has resulted in premature leakage or the buildup of corrosion products, making the valve difficult to operate. With some alloys, galling will occur at the mating surfaces.

Designs for lubricating these surfaces have not been completely successful because of an eventual breakdown of the lubricant by the corrosive.

A valve designed to overcome these difficulties is shown in Fig. 2a. Here, body and plug of the



NEW EVAPORATOR SPEEDS GELATIN PRODUCTION

Gelatin, like other heat sensitive food products must be processed quickly if a pure, high-quality product is to be obtained. The double-effect, long-tube, vertical Swenson evaporator shown above was specially engineered for minimum product retention. A 3 per cent gelatin solution is processed at the high rate of 11,500 lbs. per hour, yielding a top-grade 20 per cent solution required for drying. A thorough understanding of the problem, careful planning and engineering, and the finest construction produced this efficient, stainless unit, adaptable to the processing of many food products. Its quality is typical of all Swenson equipment for the food, chemical, and petroleum industries. Whatever your needs in evaporators, spray dryers, crystallizers, or special equipment, call on your Swenson engineer.



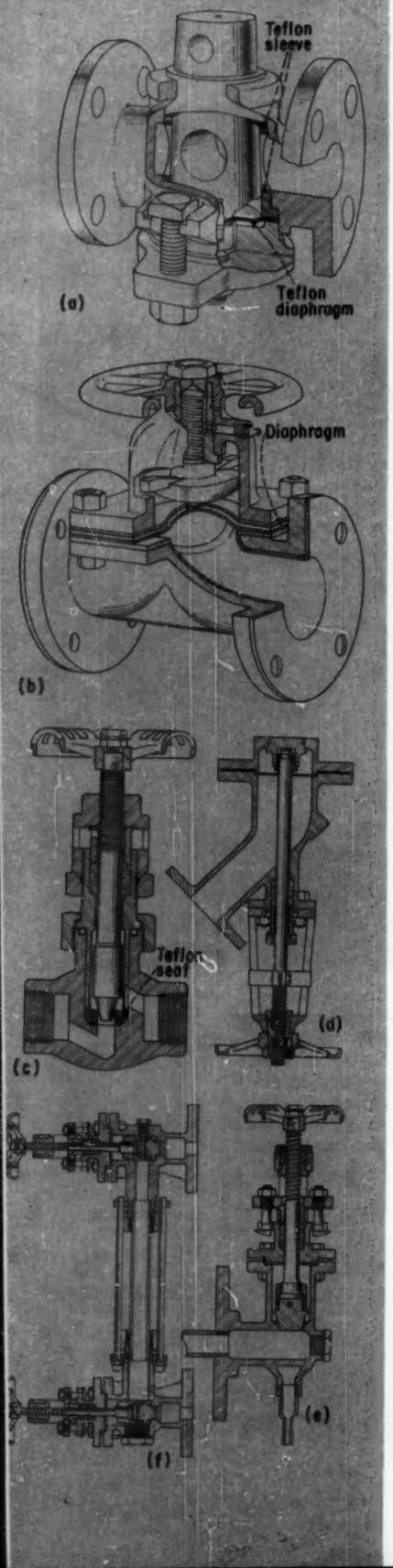
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proper alloy for a specific application is separated by a Teflon sleeve which provides positive sealing and eliminates the need for lubrication. A Teflon diaphragm acts as a friction ring between the bottom of the plug and the adjusting plunger, sealing the bottom of the valve. This valve turns easily and is practically maintenance-free.

▶**Diaphragm Valve**—The diaphragm valve (Fig. 2b) is produced with bodies of various corrosion-resistant alloys or with steel or cast iron bodies lined with a suitable nonmetallic material. This valve consists of three simple elements: the valve body, the valve diaphragm and valve bonnet assembly. The diaphragm serves as the closing or seating member as well as the partition that separates the valve working parts in the bonnet from the fluid passageway.

The diaphragm is not used simply as a packing substitute, but instead as a dynamic seating element which eliminates any need for the conventional valve-stem packing assembly. Diaphragm can be made of numerous natural-rubber base and synthetic-plastic materials.

▶**Needle Valve**—Fig. 2c shows an ingenious needle valve development.

To eliminate seat damage by galling or wear common to valves employing metal-to-metal seating, this valve is equipped with a Teflon body seat which permits tight closure without damage to the stem-seating surface. The Teflon seat is retained by a sleeve which is an integral part of the valve bonnet.

To eliminate the undesirable feature of inside screw construction and thus exposure of the stem threads to the corrosive fluid, this valve is equipped with a threaded yoke outside the packing area in which the stem threads operate. Also, to avoid undesirable crevice attack in threads when a threaded-in bonnet construction is used, this valve is equipped with a union bonnet, the threads of which are sealed from the fluid being handled by a bonnet flange seat and "O" ring seal.

▶**Flush-Bottom** — A flush-bottom tank valve (Fig. 2d) is designed for installation in the bottom of reaction or mixing vessels where complete drainage is essential.

The top surface of the flange adapter, in which the seat is located, will be flush with the tank bottom when the flush-bottom valve is installed.

▶**Sampling Valve**—Need for a well-designed valve for liquid sampling resulted in the development shown in Fig. 2e. This incorporates the desirable features of outside screw and yoke, swivel disk and bolted bonnet.

The inlet flange bore is tapped to allow installing a pipe of suitable dimensions for taking samples remote from the vessel wall. A surge pocket, cast into the body beyond the valve seat, assures a smooth, nonsputtering flow at the outlet.

▶**Gage Glass Fittings**—Fig. 2f shows one combination of gage-glass fittings for determining the level of a corrosive liquid in a vessel. Valves in this assembly have construction features known to be desirable. In this particular design the gage glass bore in the valve bodies is offset from the plug bore to facilitate removal and cleaning of the glass.

▶**Still More Valves**—This discussion, by no means, completely covers the field of valves for corrosive service. We should mention that special nonmetallic valves are available: chemical porcelain Y valves; impervious-graphite globe and diaphragm valves; plastic globe, plug, diaphragm, pinch and gate valves.

However, the foregoing should give an indication of the progress made by valve manufacturers in their efforts to satisfy specific chemical industry requirements.

◀**SPECIAL VALVES handle corrosives: (a) Teflon-lined plug, (b) diaphragm, (c) Teflon-seat needle valve, (d) flush bottom, (e) sampling valve, (f) gage-glass valves—Fig. 2**

ACKNOWLEDGMENT

For their assistance in the preparation of this paper the author wishes to thank R. E. Boller, Alloy Steel Products Co.; William Heilig, The Wm. Powell Co.; D. C. Huber, Cooper Alloy Corp.; Robert McFarland, Hills-McCanna Co. and John S. Haddick, The Duriron Co.

PERMOBOND LININGS



"U.S." PERMOBOND LININGS APPLIED BY RUBBERCOTE, INC., BARTOW, FLORIDA, FOR KAISER ALUMINUM

should last at least 7 times longer

Huge, 100,000 gallon acid-storage tanks are a necessity with Kaiser Aluminum & Chemical Corporation . . . and *were* a *problem*. The redwood tanks previously used for storage of incoming hydrofluosilicic acid deteriorated rapidly, sprang costly-to-repair leaks, lasted for only 2½ years.

New tanks are now being erected, protected with Permobond, the rubber lining that is unaffected by a wide variety of highly corrosive "problem" chemicals. While no performance figures are yet available, naturally, the experience of other chemical manufacturers, processors and users has led Mr. J. A. Watson, Superintendent of the Kaiser Aluminum plant in Mulberry, Florida, to estimate a minimum life for the new Permobond®-protected tanks of at least 15 to 20 years. It is quite possible, in fact, that the acid will serve to *protect* the Permobond lining from eventual weakening from *other, outside* causes!

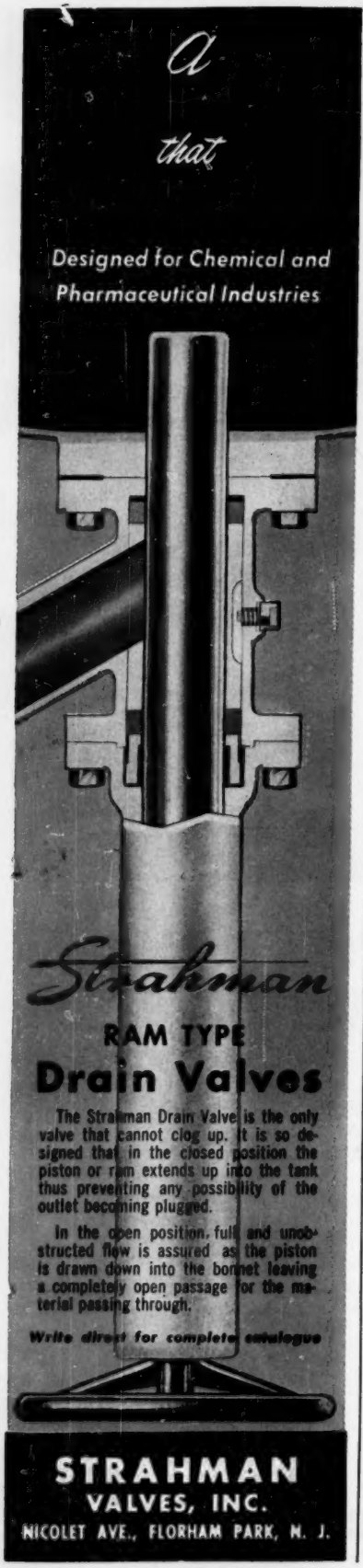
Used by Kaiser Aluminum and a wide variety of progressive companies for its demonstrated superiority over other lining materials, Permobond can be applied to existing as well as new equipment. Your local Permobond Applicator will be glad to provide you with Permobond protection service . . . select the compound, prepare the surface, apply the rubber and vulcanize the entire lining. *Get in touch with "U.S." at address below for Authorized Permobond Service in your locality.*

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INDUSTRY NEWS . . .

(*Continued from p. 72*)

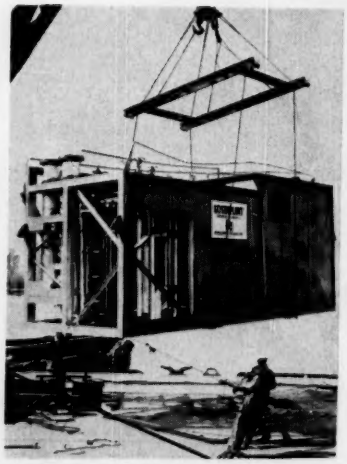
Rexall Drug & Chemical Co. is making a joint venture with **El Paso Natural Gas Co.** into the field of petrochemicals. The venture includes erection of plants at Odessa, Tex., to make olefins, polyolefins and chemicals. First plants will start up early in 1962, making ethylene, propylene, polyethylene (both conventional and linear) and polypropylene. Initial olefin capacity will be over 200 million lbs./yr., polyolefin capacity over 150 million lbs./yr.

Rohm & Haas Co. has acquired an idle plant at Louisville, Ky., which the government formerly used in making butadiene. Rohm & Haas will not make butadiene there, may spend as much as $10 million to convert the plant for other uses. Initial production, to begin in 1961, will consist of acrylic plastics.



The Long Beach Gas Department (Long Beach, Calif.) has at its disposal the world's largest Wiggins gas holder, shown above. Towering 17 stories high, it is built to store 5 million cu. ft. of natural gas. It was designed, engineered and constructed by General American Transportation Corp., and it cost $1.4 million.

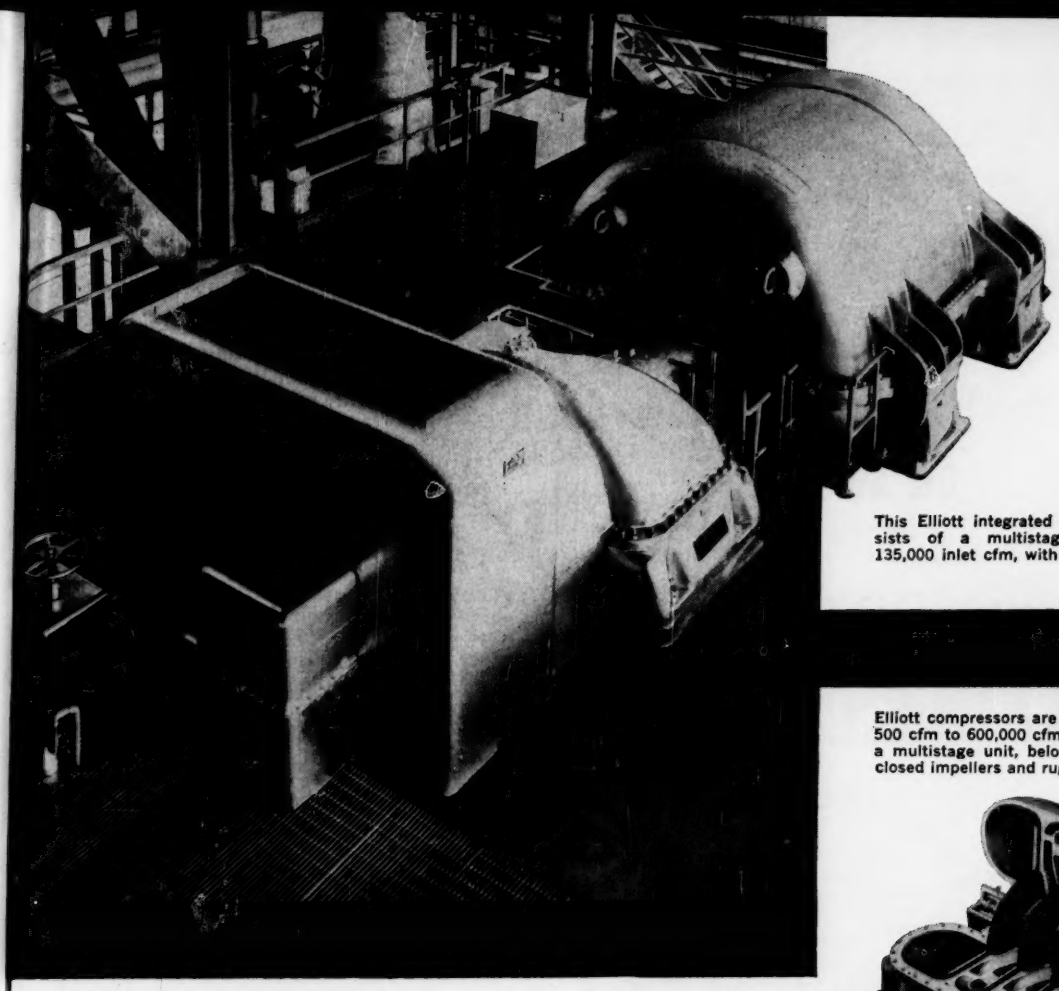
Monsanto Chemical Co. announces that it is upping its bulk aspirin manufacturing capacity at St. Louis. The increase, amounting to 25%, is being applied to a unit which is already the largest bulk aspirin facility in the world. Operation with the expanded capacity is expected to begin late this summer.



Hydrocarbon Research, Inc., designed and fabricated the 420-ton/day oxygen plant which can be seen in part above. Designed to feed furnaces and converters of the Wheeling Steel Corp. at Steubenville, Ohio, it will be operated jointly by HRI and Wheeling Steel through a subsidiary company.

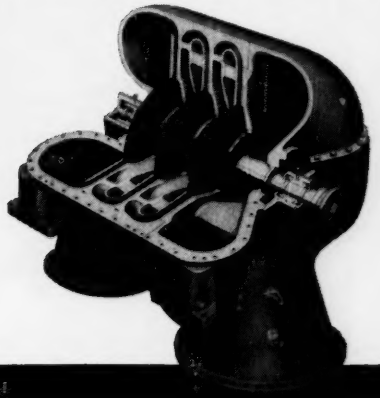
American Gilsonite Co., joint affiliate of Standard Oil of California and Barber Oil Corp. of New York, has announced an expansion program which will double capacity of its refinery at Grand Junction, Colo. Company will install a new coking furnace, a third steam boiler, and flotation cells and tanks. Expanded daily output from the refinery will be 1,600 bbl. gasoline, 1,300 bbl. railroad fuels and 350 tons coke.

Hooker Chemical Corp. plans to erect a building for semicommercial production processes at its Niagara Falls, N. Y., plant. The new facility, to cost about $1½ million with equipment, will allow Hooker to centralize production of chemicals that have outgrown pilot-plant units but haven't reached full commercial sales volume. Equipment will be designed for maximum flexi-



This Elliott integrated compressor unit consists of a multistage compressor rated 135,000 inlet cfm, with its 12,440-hp turbine.

Elliott compressors are made in capacities of 500 cfm to 600,000 cfm. The cutaway view of a multistage unit, below, shows the welded, closed impellers and rugged casing.



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For over six years, the machine shown above has kept things moving through a 40,000-barrel-per-day fluid catalytic cracking unit in Texas. Said to be the largest of its kind when installed in 1953, it serves the catalyst circulating and regenerating system of the refinery unit as efficiently today as it did the day it was installed.

Elliott offers the most complete line of well-established centrifugal and axial flow compressors for gas and air—with matching Elliott motor or turbine drives. There are 48 compressor frame sizes, providing excellent choice for all applications over the entire range of capacities from 500 cfm to 600,000 cfm.

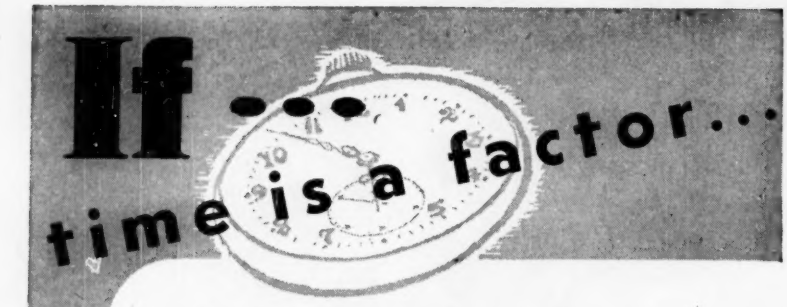
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bility, so that products can be made simultaneously or consecutively with only minor set-up changes. The building will be completed about a year from now.

New York Mining & Manufacturing Co. will install a plant to make high-grade chemical coke near Calvert City, Ky. The multi-million-dollar installation will use hard coal from Eastern Kentucky and West Virginia fields as raw material. Construction will be completed by January, 1961.

Food Machinery & Chemical Corp. plans to expand soda ash manufacture at its plant in Green River, Wyo. Production will increase 200,000 tons/yr., bringing total capacity to 750,000 tons/yr. The expansion will be completed by early 1962.

CompuDyne Corp. has leased a new 12,000-sq.-ft. plant to provide additional manufacturing facilities for computer control systems. Company began operations in it early in May. The plant is located near Hatboro, Pa.

Mobil Oil Co., division of Socony Mobil Oil Co., Inc., plans to install a delayed coking unit at its Beaumont, Tex., refinery. It will handle 20,000 bbl./day of heavy oil feed, and is the third large coker started or completed by Mobil in the past two years. (The first two: at Paulsboro, N. J., and Torrance, Calif.) Mobil expects that it will be installed by the spring of 1961.

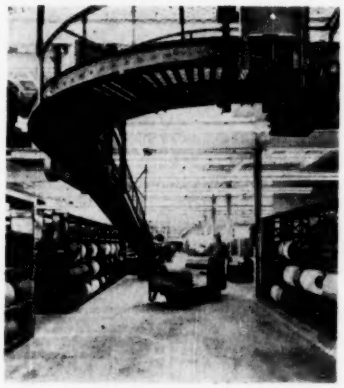
Norwalk Co., Inc., is completely renovating its compressor-manufacturing facilities at South Norwalk, Conn. Company is putting in new milling machines, cylindrical grinding machines and other equipment, as well as installing new lighting.

Colton Chemical Co., a division of Air Reduction Co., will build a new resins plant at City of Industry (in Los Angeles County), Calif. Scheduled for completion this year,

it will produce Colton's Flexbond and Vinac resins.

Food Machinery & Chemicals Corp. is now constructing two new plants to produce insecticides, herbicides and fungicides. One is at Greeley, Colo.; the other is at Ayden, N. C. Both are to be completed this spring.

General Electric Co. has broken ground for a $1-million facility which will make silicone fluids finished products. Its site is GE's plant at Waterford, N. Y.

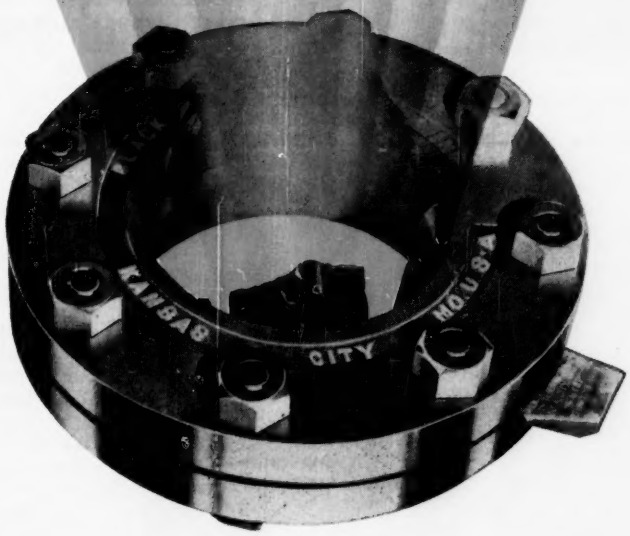


Norton Co. has put into operation a new $6½-million plant at Worcester, Mass., to expand its facilities for making organic bonded grinding wheels. A 620x320-ft. structure, the plant employs 450 people and features automatic production equipment. Seen above is part of the storage area; in all, the company has 26 mi. of shelves for finished product storage.

Celanese Corp. of America announces completion of new research laboratory by its subsidiary, Amcel Propulsion Inc. The building contains laboratories and associated facilities for research and development on high energy chemicals, propellants and explosives, thus supporting Amcel's participation in rocket and missile programs.

Standard Oil Co. of Calif. will add additional facilities to its refinery now under construction near Honolulu. The re-

This "heart-failure" can lengthen someone's life!



Pictured above is what happens when a pressure vessel protected by a BS&B Safety Head develops pressures above safe limits. "Heart" of the Safety Head is the rupture disc, which bursts to relieve the overpressure instantly and completely—guarding against injuries to personnel and damage to plant equipment.

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If you use any type of pressured system, let us tell you more about BS&B Safety Heads and rupture discs. Call or write your nearest BS&B office or representative—or write to . . .



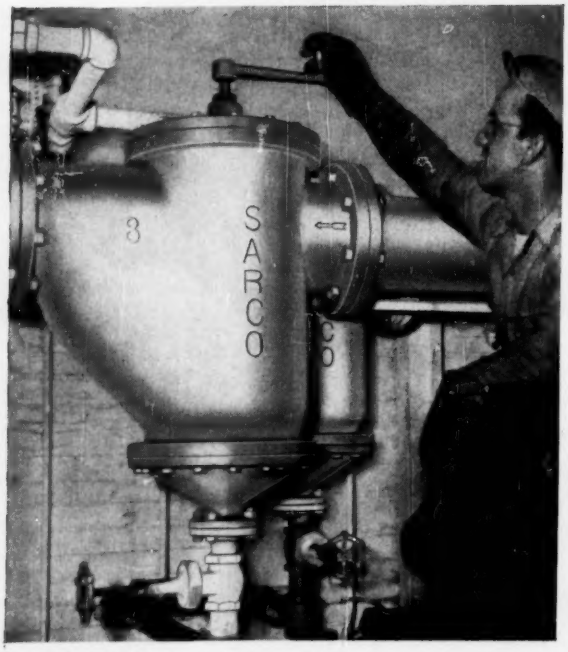
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SARCO TOPICS

How correct strainer selection protects equipment, maintains fluid flow, and prevents shut-downs

Strainers for wash water for power plant condensers cleaned without shut down



Sarco Type VRS Rotary Scraper Strainers enable operators to clear the screens with a few turns of the crank, without shutting down the line or dismantling the strainer.

Sizable quantities of water are required for cleaning condenser water screens at a power plant in California. Sea water is pumped for the purpose and must be freed from debris and sea life such as mussels and sardines. Further, any screening devices used must be capable of cleaning without shut-down.

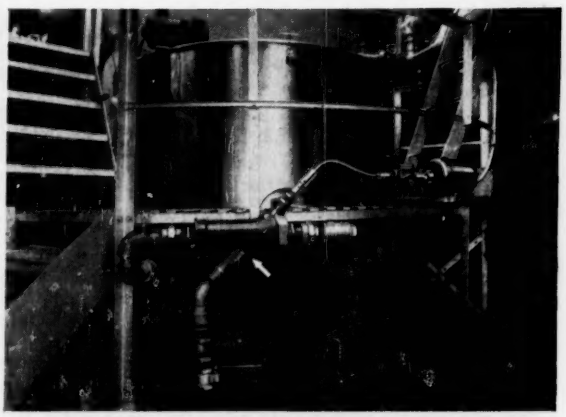
These problems were met by installing two Sarco type VRS scraper strainers ahead of the wash water pumps. This type of strainer is cleaned by rotating a spiral blade either manually or by motor drive. Motor-operated rotary-type strainers make it possible to clean the strainer continuously. The blade scrapes the screen clear, and collected solids are blown down from the strainer as required. Clean screens minimize pressure drop. The Sarco strainer installation has materially reduced maintenance hours and insured against temporary shut-down caused by clogged strainers.

Helical scraper knife clears screen without shutdown in East Chicago Air Conditioning System

Offices of the Inland Steel Company, at East Chicago, Indiana, are cooled with air conditioning units of 7½ tons and larger. Water for condenser cooling is pumped in from Lake Michigan.

Although passing through traveling screens, the incoming water still contained fine sand which clogged the screens. Frequent cleaning was required, and every now and again the units were practically out of service.

Plant engineers found their answer in Sarco Rotary Scraper Strainers, Type VRS. These units incorporate a hand-operated helical scraper knife within the cylindrical strainer screen. These scrapers made it possible to keep the strainers clean simply by cranking the scraper a few turns at regular intervals. Sand scraped off the screen is blown clear and discharged at pressure through a manually operated valve to waste. Now it is not necessary either to dismantle the strainer or shut down the unit.



IN PROCESS APPLICATION This Sarco motor operated-Scraper Strainer, Type SRS, is used to strain chocolate syrup in a processing application, providing continuous flow of fluid without shut-down for maintenance. 2167

For information on Sarco strainers, contact your Sarco sales representative, district office, or distributor; or write—

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.
STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

vised version will give the mid-Pacific area its first complete petroleum processing plant, and will nearly double Stancal's original $33-million investment in the Hawaiian venture. New facilities, supplementing those now under construction, will include a 13,000-bbl./day fluid catalytic cracker and alkylation unit; hydrogenation and isomerization units; a CO boiler, dust precipitator and sulfur recovery equipment; and additional tankage. Initially-planned facilities will be completed late this year, and the additional equipment will be on stream in 1962.

Ideal Cement Co. will start building North Carolina's first cement plant late this year, at a site on the Cape Fear River near Wilmington. Plant will produce 1.5 million bbl./yr. of cement from locally-mined marl, and is scheduled for startup by 1962.

Hartford Fibres Co. announces a September opening for its Zantrel polynosic fiber plant at Rocky Hill, Conn. It will be the first U.S. producer of Zantrel, a fiber currently imported from France.

Big Three Welding Equipment Co. of Houston is planning a $1-million plant at Orange, Tex., to make liquid nitrogen, liquid oxygen and gaseous nitrogen. Daily capacities will be 17½ tons each for the liquid products, 90 tons for nitrogen gas. Startup is set for Jan. 1, 1961. A highly automatic plant, it will employ about 12 people.

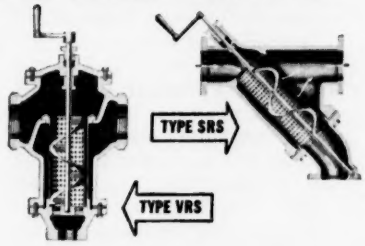
General Aniline & Film Corp., Dyestuff & Chemical Division, announces the first step of a five-year expansion program for its Calvert City, Ky., plant. Company will expand plant facilities for manufacture of such acetylene chemicals as pyrrolidone and vinylpyrrolidone, and also for surfactants and intermediates.

Control Data Corp. has established a computing center at

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PIPELINE STRAINERS
help prevent shutdowns
HANDLE ALL MEDIA
condensate, steam, water, oil, and other piped fluids
PROTECT ALL EQUIPMENT
temperature and pressure regulators, steam traps, pumps, meters, burners, compressors, hydraulics, lubricators, and nozzles.
AVAILABLE IN ALL TYPES AND SIZES

SCRAPER STRAINERS
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Also Sarco Y-Type strainers in cast iron, brass, and semi-steel, screwed and flanged, all sizes and pressures.

For information on Sarco strainers, contact your Sarco sales representative, district office, or distributor; or write— 2166

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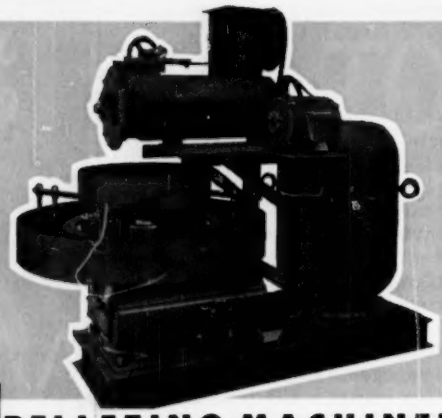


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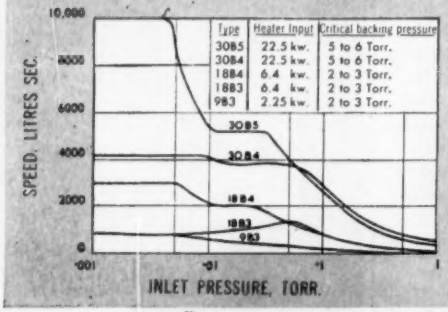
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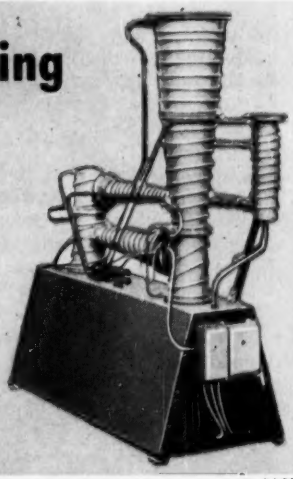
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AIR SPEED—4,500 litres / second

THROUGHPUT—1 million litre-micron/second



Type	Heater Input	Critical backing pressure
3085	22.5 kw.	5 to 6 Torr.
3084	22.5 kw.	5 to 6 Torr.
1884	6.4 kw.	2 to 3 Torr.
1883	6.4 kw.	2 to 3 Torr.
983	2.25 kw.	2 to 3 Torr.



Model 3084

"SPEEDIVAC" (Regd.)

VAPOUR BOOSTER PUMPS

"Speedivac" vapour booster pumps are designed especially for those chemical processes demanding high speed pumping over a wide pressure range. High performance standards are maintained even with the presence of contaminating vapours and solvents. Three important features, high speed, high critical backing pressure and low heater input are found in all Speedivac vapour booster pumps. Write for complete information to:

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its Minneapolis home office. Reported to be the highest-capacity commercial center operating in the U.S., it will use the company's solid state digital computer, the 1604, as its main facility. (The 1604 can store 32,768 48-bit words on its magnetic cores.) Control Data will also install some of its Model 160 desk-size computers this summer. Main purposes of the new center: to provide computing time for Control Data's customers to test out their problems; to offer computing time on a service-bureau basis to universities and scientific or business organizations; to help Control Data's engineers design and test new equipment; and to facilitate the company's own accounting procedures.

Monsanto Chemical Co. will build a new unit to manufacture phthalate esters at its Long Beach, Calif., plant. It is to be operating by mid-1961. The company also disclosed that construction is under way to double its Long Beach bulk storage and blending facilities for the esters, which are now produced at Monsanto's plants at St. Louis and Everett, Mass.

Crown Zellerbach Corp.'s chemical complex to produce dimethyl sulfide and dimethyl sulfoxide is now under construction. The Bogalusa, La., facilities are being engineered and built by Fluor Corp., and will cost over $1.5 million. Completion is expected this fall.

Hooker Chemical Corp. is installing facilities at Jeffersonville, Ind., to make sodium hexametaphosphate. Company expects the installation to be completed by December.

Arabol Manufacturing Co. is expanding its facilities for producing adhesives. Expansion includes a newly-completed plant in Marietta, Ga.; start of construction this summer on a plant at Delaware, Ohio; negotiations for

construction of another plant at an undisclosed location; and streamlining of Arabol's existing facilities.

Allied Chemical Corp. announces a major research expansion which will more than double the laboratory facilities of its General Chemical Division near Morristown, N. J. Construction is to be completed in the last quarter of 1961.

Food Machinery & Chemical Corp. reveals that its Niagara Chemical Division will build a research center at Middleport, N. Y. The new facility will be used for pesticide research and development.

California Anodizing Co. is a new firm organized in South San Francisco, Calif., which will specialize in treating aluminum products. It recently opened a plant, costing over $250,000, reported to be the largest aluminum-treating plant in the Bay Area.



CompuDyne Corp. has recently acquired American Measurement & Control, Inc., a designer and manufacturer of electromechanical and electro hydraulic servomechanisms. (*Chem. Eng.* described this acquisition incorrectly in its May 16 issue, p. 180.)

Celanese Corp. of America has broadened its plastics packaging materials line by purchasing Plastic Horizons, Inc. Latter firm has been a major independent producer of polyethylene film, with plants at Paterson, N. J., and Batavia, Ill. It will continue to operate essentially intact within the Celanese organization.

Spencer Chemical Co. will acquire the assets of The Pitts-



exclusive direct unloading system cuts CO_2 handling costs

To be sure you get rock bottom CO_2 costs, investigate this exclusive method of handling CO_2 shipments. It's Olin Mathieson's patented Direct Unloading System in which CO_2 flows directly from special insulated tank cars to your process.

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Newest plastic pump design! Molded from Penton* for widest possible corrosion resistant service even at elevated temperatures. Safely handles corrosive chemicals such as concentrated sulphuric acid, concentrated chlorine solutions, ferro-cyanide bleach and concentrated sodium hydroxide. Features high operating efficiencies, excellent balance, low maintenance.



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Size: 1" outlet x 1¼" IPS inlet.
Materials: Body, impeller and seal housing in Penton.*
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burg & Midway Coal Mining Co. in exchange for common stock, if shareholders of the two companies approve the move. Latter company is an established coal producer in the Midwest, with assets amounting to about $20 million.

The Yale & Towne Manufacturing Co. announces that the Cincinnati Branch of its Yale Materials Handling Division has been purchased by the newly-formed Moon Equipment Co. Moon will be the franchised representative for Yale industrial lift trucks and tractor shovels in parts of Ohio and Kentucky.



OVERSEAS BRIEFS

Italy is building three commercial-scale nuclear power plants, which will cost a total of $240 million. One is slated for the province of Vercelli, another will be built on the Garigliano River midway between Rome and Naples, and the third will be built near Rome. Size of the Vercelli plant was not disclosed; the other two stations will be rated at 230,000 and 200,000 kw., respectively.

Venezuela: An affiliate of Mobil International Oil Co. has started operation in a $30-million oil refinery near Puerto Cabello. The Caribbean coast facility has a capacity of 50,000 bbl./day, and will process crude from Barinas Province in southwestern Venezuela. Output will include kerosene, jet fuel, diesel oils, heavy fuel oils and three grades of gasoline. (A nearby lube blending plant furnishes lubricants for the Venezuelan market.)

Japan: A Houdry dehydrogenation process unit has gone on stream for the Japan Synthetic Rubber Co., Ltd., in

URANIUM PROCESS PLANT...

PIPED BY MIDWEST For this $50,000,000 Atomic Energy Commission uranium processing plant...

4,365 PIPING ASSEMBLIES of stainless and carbon steel were fabricated and erected by Midwest...

567 PUMPS AND VESSELS and other mechanical equipment were installed by Midwest... as well as

1,186 MAJOR INSTRUMENTS including control valves, flow meters, etc.

A **360-MAN** Midwest field erection crew completed the job on schedule.

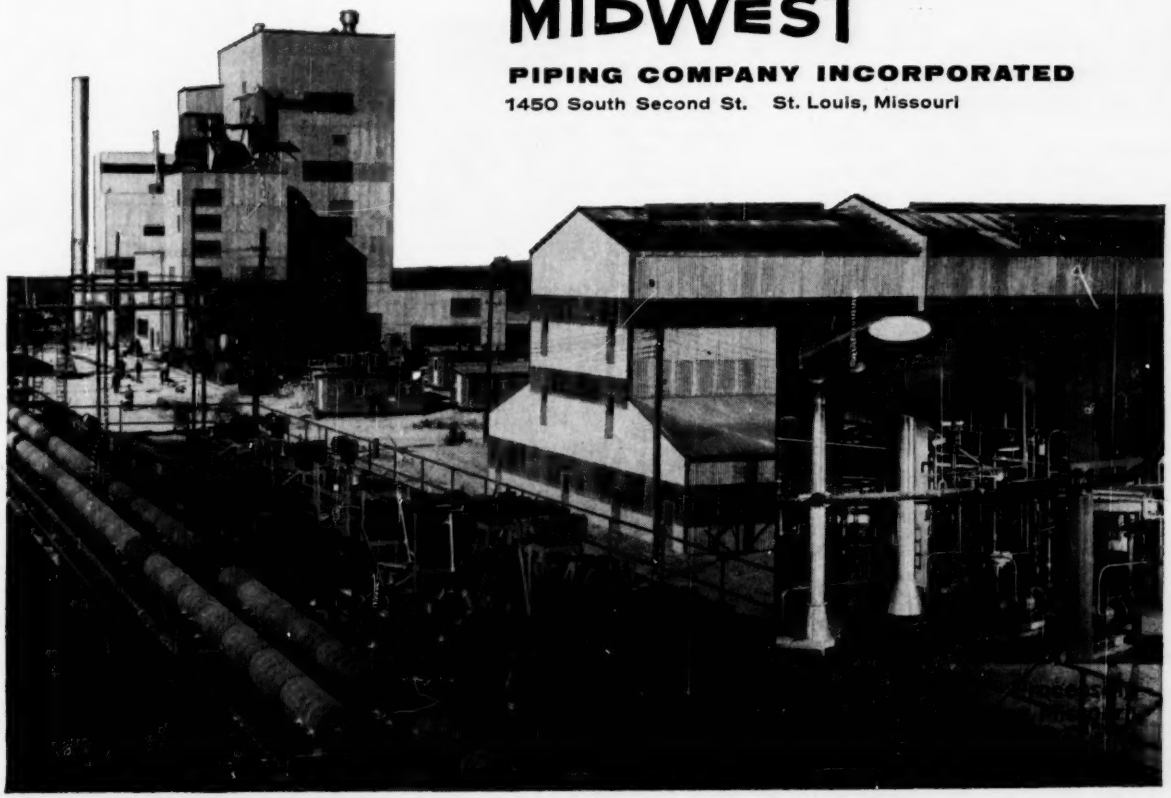
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Troubles coming in waves? Try Ace-Ite pipe

Ace-Ite Plastic Pipe . . . a tough, chemical-resistant ABS rubber-resin blend . . . is the surest way to stem the tide of corrosion. One of eight types of Ace pipe, it's ideal for general use, handles most chemicals. It's been around long enough so we know what it'll do. And you'll like the price. *Ask for Bulletin CE-80.*

Ace chemical-resistant rubber-lined steel pipe best for high-pressure, big sizes, or abrasives. Pipe, fittings and valves 1½ to 24".



Highly efficient *WE* pump. Capacity to 360 gpm. Cast iron, fully protected by top quality, chemical resistant hard rubber lining.



Design assistance and facilities for molding special fittings, pump parts, etc., of plastics or hard rubber. Also large hand-fabricating facilities.



Variety and quality to match *any* plastic piping. Riviclor PVC, Ace-Ite rubber-plastic, Parian poly, Ace Saran, Tempron high temperature nitrile, hard rubber-lined steel.



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See ACE equipment in Chemical Engineering Catalog

Yokkaichi. It produces butadiene, and has a capacity of 25,000 tons/yr.

Australia: Pacific Chemical Industries Pty. Ltd., a new joint venture of an Australian Stauffer affiliate and the Ugine group of France, is building a $2-million chemical plant. Scheduled to start up early in 1961, it will initially produce fluorocarbons (which Australia currently must import) and will later branch out into other chemical areas.

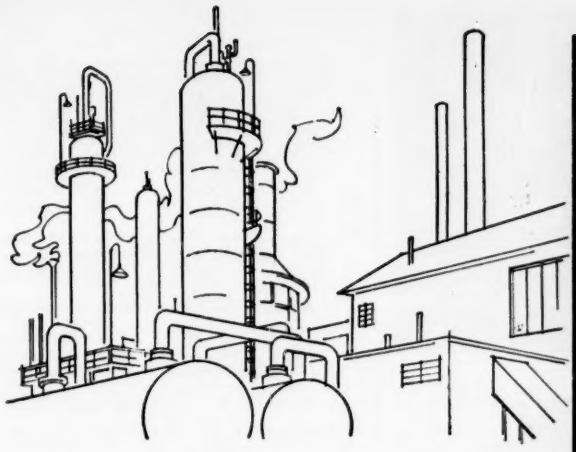
U.S.S.R.: A new synthetic rubber plant has reportedly gone into production in the Bashkir Autonomous Republic. The unit is at Sterlitamak, and operates on butane gas feedstock.

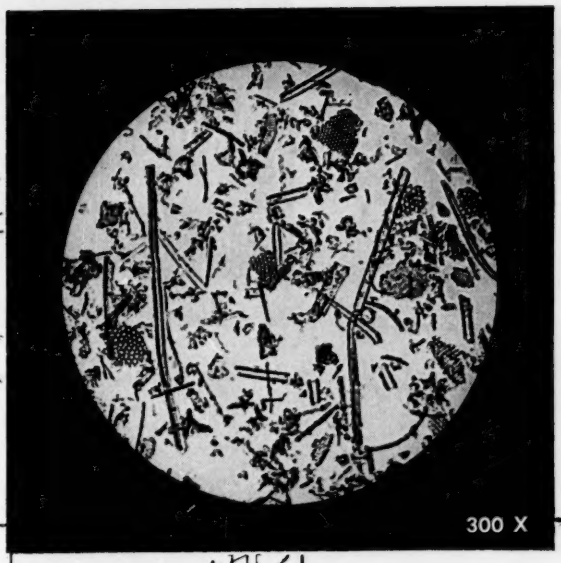
Northern Ireland: The Du Pont Co. (U.K.) Ltd. has started making neoprene synthetic rubber at its Maydown Works in Londonderry. Plant output will be sold in the United Kingdom and other European markets.

West Germany: Badische Anilin & Soda Fabrik will build a chemical laboratory at Ludwigshafen, billed as the largest one in Europe. It will cost about $12 million.

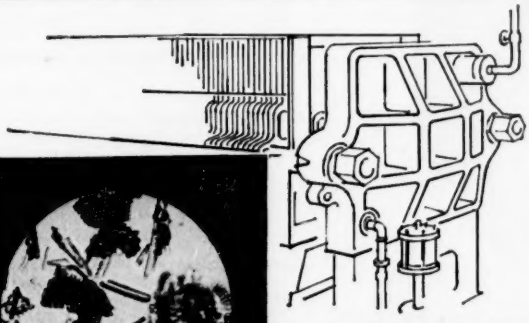
Egypt: The National Cement Co. has started making blast furnace cement at a new plant in Tebbin, south of Cairo. This marks the first production of ferrous cement in the Middle East. National's plant has a design capacity of 500,000 tons/yr.; its product contains 35% blast furnace slag.

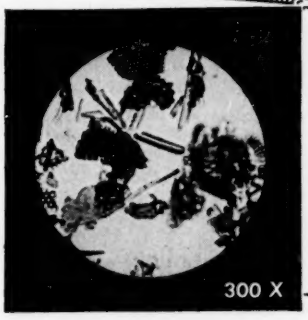
England: Construction work is well under way for the Shell Chemical Co., Ltd., polyolefin plant at Carrington in Manchester. Upon completion in early 1961, the plant is scheduled to produce 30,000 long-tons/yr. polyethylene and polypropylene. Ultimate annual capacity will be 50,000 long tons; about one-fifth of this will be high-density polyethylene.





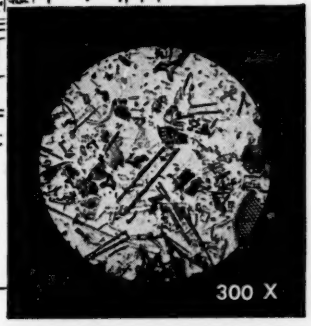
For flow rate plus clarity—Hyflo Super-Cel has the right combination of large and fine particles. Heavily used in chemical processes such as caustic soda production.





For fast flow rates—Celite 545 has a higher proportion of coarse particles. Frequently used for clarification of resins and other viscous liquids.





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Celite 545, for example, with a higher proportion of large to fine particles, is used to remove large suspended impurities at maximum flow rates. *Hyflo Super-Cel®* has a balanced particle size distribution, combines good liquid clarity and moderate flow rate. But *Filter-Cel®* has a much higher ratio of small particles, is tailored for use where high clarity outweighs flow rate.

Whatever your filtration problem—Johns-Manville can furnish the "right" grade for the job. You have a choice of 9 intermediate grades *plus* many special grades. Each comes from the largest and purest commercially available deposit. Each is processed and graded at the same plant under the same uniform conditions.

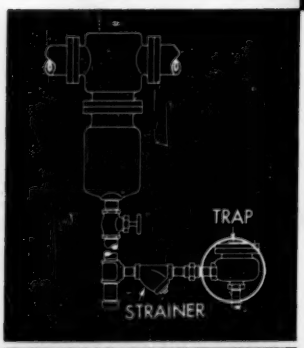
For information on specific filtration or mineral filler problems, talk to your nearby Celite engineer, or write to us. Johns-Manville, Box 14, N. Y. 16, N. Y. In Canada, Port Credit, Ont.

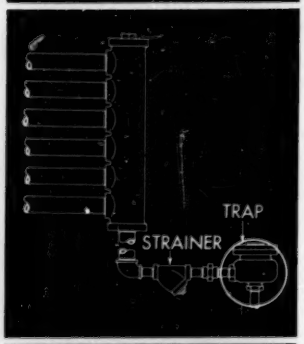
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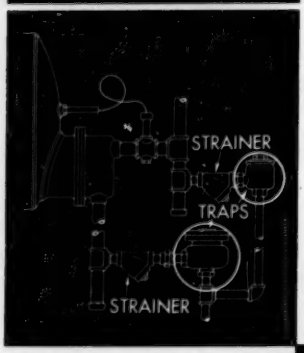
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When you aren't getting top efficiency from your equipment . . . when leaking, dribbling steam waste lessens its full usefulness . . . when air or other non-condensables cause trouble . . . where do you look? Your steam traps! That's why it's mighty important that they (1) fully discharge condensate, air and other non-condensables promptly and (2) give long trouble-free service. Nicholson traps meet the first requirement because they operate on a *true balanced pressure* principle . . . and the second, because they only have one moving part, thus reducing the possibility of down-time. Other advantages are positive shut-off . . . high capacity . . . rigid pretesting.

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CALENDAR

The University of Michigan, Engineering Summer Conference, Topics in Multiphase Flow.
June 22-July 1 Ann Arbor, Mich.

Rochester Institute of Technology, Design of Experiments for the Chemical and Processing Industries.
June 23-30 Rochester, N. Y.

International Federation for Automatic Control, first international congress, sponsored by A. A. C. C.,
June 25-July 5 Moscow, U. S. S. R.

American Society for Testing Materials, annual meeting and exhibit, Chalfonte-Haddon Hall.
June 26-July 1 Atlantic City, N. J.

International Congress on Catalysts, Maison de la Chimie.
July 4-8 Paris, France

Gordon Research Conference, Polymers, Colby Junior College.
July 4-8 New London, N. H.

Pennsylvania State University, under water missile engineering seminar.
July 10-22 University Park, Pa.

Gordon Research Conference, Statistics in Chemistry and Chemical Engineering, New Hampton School.
July 11-15 New Hampton, N. H.

Gordon Research Conference, Corrosion, Colby Junior College.
July 18-22 New London, N. H.

Massachusetts Institute of Technology, Dynamics and Control of Chemical Engineering Processes.
July 18-29 Cambridge, Mass.

Western Packaging & Materials Handling Exposition, Los Angeles' Pan Pacific Auditorium.
July 19-21 Los Angeles, Calif.

Gordon Research Conference, Separation and Purification, Colby Junior College.
July 25-29 New London, N. H.

Gordon Research Conference, Instrumentation, Colby Junior College.
Aug. 1-5 New London, N. H.

University of California, Gas Chromatography.
Aug. 2-5 Los Angeles, Calif.

Gordon Research Conference, Organic Coatings, New Hampton School.
Aug. 8-12 New Hampton, N. H.

Technical Assn. of the Pulp and Paper Industry, 9th Pulp and Paper Statistics Course, Brevard College.
Aug. 8-19 Brevard, N. C.

American Institute of Chemical Engineers & American Society of Mechanical Engineers, National Heat Transfer Conference and Exhibit Statler Hotel.
Aug. 14-17 Buffalo, N. Y.

American Society of Mechanical Engineers, Heat Transistor Division Conference, Statler-Hilton Hotel.
Aug. 15-17 Buffalo, N. Y.

National Bureau of Standards, Cryogenic Engineers Conference.
Aug. 17-19 Boulder, Col.

Technical Association of the Pulp and Paper Industry, 14th Alkaline Pulping Conference, Multnomah Hotel.
Aug. 22-24 Portland, Ore.

University of Colorado, 1960 Cryogenic Engineering Conference.
Aug. 23-25 Boulder, Col.

Association For Computing Machinery, National Meeting, Marquette University.
Aug. 23-25 Milwaukee, Wisc.

Technical Association of The Pulp and Paper Industry, Forest Biology Conference.
Aug. 24-27 Seattle, Wash.

The Combustion Institute, 8th International Symposium, California Institute of Technology.
Aug. 28-Sept. 2 Pasadena, Calif.

Public Health Service, Water Quality Measurement and Instrumentation Symposium, Sanitary Engineering Center.
Aug. 29-31 Cincinnati, Ohio

Air Force Office of Scientific Research, 8th International Combustion Symposium.
Aug. 29-Sept. 2 Los Angeles, Calif.

Chemical Institute of Canada, Nuclear and Radio-Chemistry Symposium, Chalk River Laboratories.
Sept. 6-8 Chalk River, Ontario

Production Engineering Show, Navy Pier.
Sept. 6-16 Chicago, Ill.

Machine Tool Show, International Amphitheatre.
Sept. 6-16 Chicago, Ill.

Massachusetts Institute of Technology, Joint Automatic Control Conference.
Sept. 7-9 Cambridge, Mass.

American Chemical Society, National Meeting.
Sept. 11-16 New York, N. Y.

Canadian Agricultural Chemicals Assoc., 8th Annual Meeting and Conference, Britannia Hotel.
Sept. 12-14 Muskoka, Ontario

American Society of Mechanical Engineers, Engineering Management Conference.
Sept. 15-16 Chicago, Ill.

American Institute of Chemical Engineers, National Meeting, Mayo Hotel.
Sept. 25-28 Tulsa, Oklahoma

American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Jung Hotel.
Sept. 26-28 New Orleans, La.

Instrument Society of America, Instrument-Automation Conference and Exhibit, Coliseum.
Sept. 26-30 New York, N. Y.

International Electrostatics Conference, University of Grenoble.
Sept. 27-Oct. 1 Grenoble, France

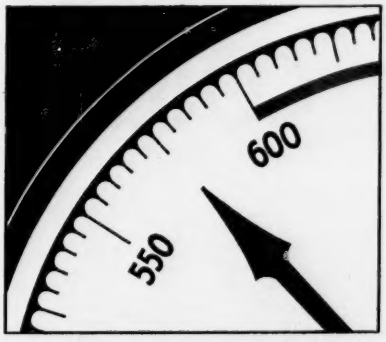
Society of Plastics Engineering, Inc. Plastics vs. Corrosion, Mark Hopkins Hotel.
Oct. 5 San Francisco, Calif.

The American Ceramic Society, Refractories Division Meeting, Bedford Springs Hotel.
Oct. 6-8 Bedford, Pa.

AROCLOR SYSTEMS DELIVER STEADY PROCESS HEAT TO 600°F and . . .

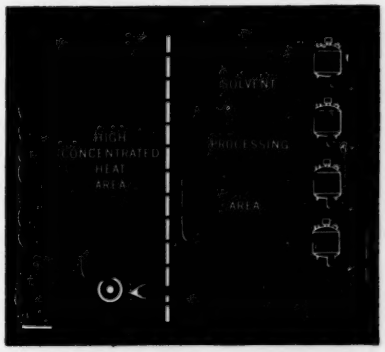
PINPOINT HEAT CONTROL...

to within 2° F. Indirect heating with Aroclor 1248 ends processing problems from local hot spots and overheating. Units range from small, portable electric types to large, gas- and oil-fired heaters generating up to 20,000,000 BTU's per hour. Typical uses: cooking of alkyd resins, dyestuff synthesis and other chemical reactions, deep-fat frying and other food processing, drying ovens and molding equipment.



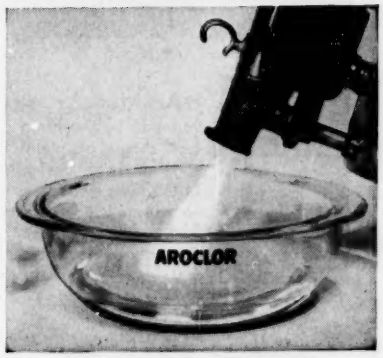
ECONOMY!

Unpressurized systems cost less to install and maintain than pressurized systems. Forced circulation of liquid Aroclor requires no condensers, vaporizers, traps, heavy-walled jackets or complex feed mechanisms. Compact design saves space. Heat from a single unit can be supplied for multiple uses at different temperatures. Total efficiency saves processing dollars.



FIRE SAFETY!

Even a blowtorch won't ignite fire-safe Aroclor 1248. A heating system designed with Aroclor 1248 eliminates the hazard of the vaporized, flammable fluid or danger of direct flame processing. Operating in a closed system vented to the atmosphere, these heating systems also eliminate the threat of "live" steam or chemical vapors escaping under pressure.



Write or use coupon for guide to selecting the best system for your application.

Monsanto Chemical Company
Organic Chemicals Division
Dept. IF-4, St. Louis 66, Mo.

Please send information booklet on Aroclor 1248 heating systems and guide to heater selection.

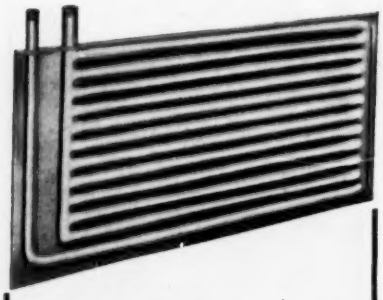
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Monsanto

WHERE CREATIVE CHEMISTRY® WORKS WONDERS FOR YOU

Aroclor Monsanto T.M., Reg. U.S. Pat. Off.

HEAT
(OR COOL)
WITHOUT COILS



DEAN PANELCOIL is more efficient than pipe coils. Gives better service under corrosive conditions. Dean Panelcoil also weighs less, costs less and is easier to install. Takes less space, too! Panelcoil is available in straight or curved sections to meet your requirements.



Dean Panelcoil formed by welding two sheets of metal together, with one or both sheets embossed, to form leakproof integral flow channels for steam, refrigerant, etc.

DEAN PANELCOIL FOR HEATING—COOLING

Write for Data Sheet 15-60 Series and Price Bulletin 259.

DEAN PRODUCTS, INC.
1039 Dean St., Brooklyn 38, N. Y.
STerling 9-5400

Backed by 25 Years of Panel Coil Manufacturing

NEW EQUIPMENT . . .

(*Continued from p. 92*)

meter when the chart is shut off.

Polyethylene protects the glass electrode from shock or handling. According to the manufacturer, price of $195 is low because of printed circuits and simplified design. — **Analytical Measurements, Inc., Chatham, N. J.** 92D



Fire Extinguisher

First one approved to fight *all types of fires.*

A new portable fire extinguisher promises to replace a variety of restricted-use units in fire hazard areas. Approved by the Underwriters' Laboratories for use against the four standard classes of fires, the ABC Allclass dispenses a powder to extinguish flames.

On paper, wood and combustible metal fires, the powder cools and insulates the flame source. The powder, in changing to an insulating deposit, absorbs heat. ABC powder also smothers and cools liquid fires, according to the manufacturer, and the powder is a nonconductor for live electrical fires.

To fight a fire, operator carries the unit upright and discharges powder. He is protected from flame heat by a cloud of powder which is nontoxic and non-abrasive. The unit is effective to −40 F.—**Alim Corp., New York, N. Y.** 166A



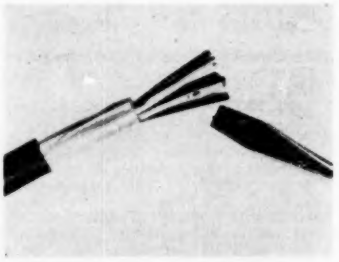
Temperature Probe

Measures surface temperature without actual contact.

Temperatures of processing rollers and drums can be measured without actual probe contact with the Gelman-Wallac rotating object thermometer which consists of a resistance sensing head and a battery-operated temperature indicator.

Probe is positioned about 0.003 in. from the surface to be measured. Heat conducted from the surface activates the resistance element. A parabolic reflector behind the element automatically compensates for conduction losses.

Small enough to be held in one hand, the temperature indicating unit runs on a flashlight battery and indicates temperature directly up to 450 F. *Probe costs $59; thermometer,* $96.—**Gelman Instrument Co., Chelsea, Mich.** 166B



TC Extension Wire

Combines multiple thermocouple leads in one cable.

Thermocouple wiring is made easier with Multi-Lead TC extension wire. Manufacturer harnesses multiple pairs of TC lead wires into special cables

NEW SUBSCRIPTION APPLICATION

Subscriptions Accepted Only From CPI Engineers, Technical Management and Senior Students. Cards Must Be Filled In Completely Before Service Starts. Students Please Include Class, Major Field and School.

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GILBARCO'S ELECTRONIC GAUGE



...the only measuring instrument that provides complete automation in gauging liquids and solids!

The Gilbarco Electronic Tank Gauge will indicate the level of most substances having a dialectric constant of 1.5 or higher, which covers virtually every solid and liquid known. Readings can then be transmitted over any distance to a remote station equipped with read-out recorders or data-loggers.

Case histories demonstrate its flexibility...

✔ At a major sugar refinery, a Gilbarco gauge met with acceptable results during a test period...assisting in the automation of this modern plant, a group of gauges will be used to measure continuous sugar level in storage silos.

✔ Polyethylene cubes have been measured successfully.

✔ An electric power plant has purchased a Gilbarco tank gauge for remote measurement of powdered soft coal in feed hoppers.

✔ Gauging of molten sulphur is another application where the Gilbarco unit is being considered.

Alcohol, asphalt, flour, wood pulp, corn and food starches are but a few of the endless commodities that can be measured. Regardless of your product, write to Gilbarco about *your* level measurement problem...

Gilbarco

GILBERT & BARKER MFG. COMPANY
West Springfield, Massachusetts



Do-it-yourself cleaning saves chemical plant $800 yearly on each exchanger

A midwest chemical plant, running a battery of eight 20-foot oil cooler exchangers, found its average cost per yearly cleaning of each exchanger was $1100. Searching ways to cut costs, they called in their local Oakite man.

Here's what happened. The Oakite man studied the exchanger set-up and the type and quantity of deposits to be removed. He recommended the particular Oakite cleaning compound exactly suited to the purpose. Then—Oakite service being what it is—he donned coveralls and boots and stayed on the job supervising and testing while circulation cleaning took place on the worst exchanger of the lot.

This exchanger had been so fouled up that when it was removed from the line it made only one degree difference in temperature change. After a 24-hour cycle of circulation cleaning, it was put back in the line. Temperature change—13 degrees! The plant men who inspected it judged it to be 95% clean.

Best of all, cost of cleaning an exchanger, including time and materials, went down from $1100 to less than $300.

Exchanger cleaning is just one of the many chemical plant maintenance operations where Oakite can help to cut costs. For the full story, talk to your local Oakite man or write for detailed literature to Oakite Products, Inc., 16H Rector Street, New York 6, N. Y.

OAKITE

over 50 Est. 1909 SCIENCE

years' leadership in industrial cleaning

which hold up to 48 (normal) or more pairs of extension wires. Cables are available from stock up to 1,000 ft., have each pair of wires numbered for easy identification.

Insulated wire-pairs are wrapped with aluminum-backed Mylar tape before being enclosed in outside sheaths consisting of PVC, steel armor, or a combination of both. Sheaths make external conduit unnecessary.—**Pyrometer Co., of America, Pendel, Pa.** **166C**



Heavy-Duty Work Glove

Made of many plies to extend service life.

Work gloves should last longer and protect hands better, says manufacturer of a new glove line. New glove is made of black moisture-proof neoprene lined inside with soft flannel material for wearing comfort.

Called Pacemaker, glove gives up to three times the wear of other coated gloves because of construction feature. Longer life is claimed because the palm and thumb crotch areas are reinforced. Extra strength in these areas protects hands and gloves when wearer handles heavy rope, wire cable and metal sheeting.

Neoprene coating resists oils, acids, bases, solvents and greases, does not impair hand flexibility or finger dexterity.—**Pioneer Rubber Co., Willard, Ohio.** **168A**

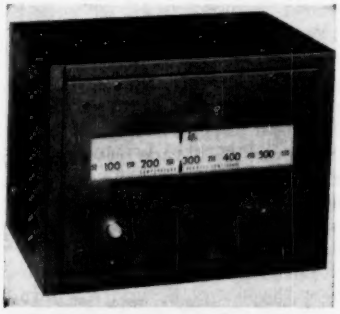


Industrial Oven

Front and back door openings make for easy loading.

Bulky products and test items can conveniently be loaded into a new industrial oven which has both front and back door openings. Loading ease is also helped by a foot-operated door release.

Good to 500 F., oven has eye-level controls which hold operating temperature within ±5 F. and prevent oven getting hotter than thermostat setting. A high velocity blower and nichrome-heated porcelain refractories provide even heating. The chamber floor will hold a 500 lb. workload. — **Electric Hotpack Co., Inc., Phila., Pa.** 169A



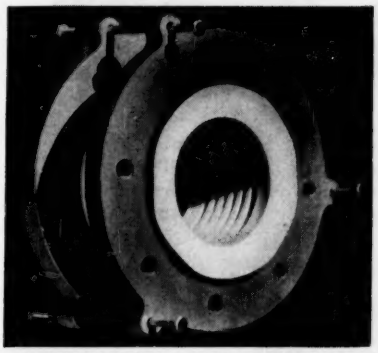
Temperature Controller

True readout of temperature over entire range.

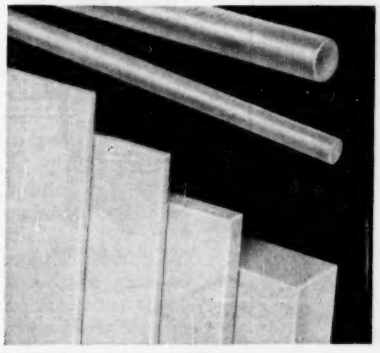
Series 5000 indicating temperature controller features a 10-in. slide rule readout based on a stable null balance servo



*du Pont Trademark



EXPANSION JOINTS • FLEXIBLE COUPLINGS



SHEETS • RODS • TAPES

Belmont Distributors in 132 key industrial areas throughout the United States can offer fast delivery of the TEFLON Products shown here because Belmont backs them with vast stocks of the most popular sizes ready for immediate shipment.

TEFLON ENVELOPE GASKETS: Round—eleven popular sizes: 1½ x 1⅞ to 8 x 11. Oval—12 x 16 x 1½. Variety of filler materials.

TEFLON EXPANSION JOINTS: Nominal pipe sizes: 1″, 2″, 2½″, 3″, 6″.

TEFLON FLEXIBLE COUPLINGS: Nominal pipe sizes: 1″, 1½″, 2″, 3″.

TEFLON SHEET: 24″ x 24″ in thicknesses 1/32″, 1/16″, 1/8″, 3/16″, 1/4″, 1/2″. 36″ x 36″ and 48″ x 48″ in thicknesses 1/16″ and 1/8″.

TEFLON TAPE: 12″ continuous width in thicknesses .010″, .020″, .030″. 24″ continuous width in thicknesses .010″, .015″, .030″, .060″.

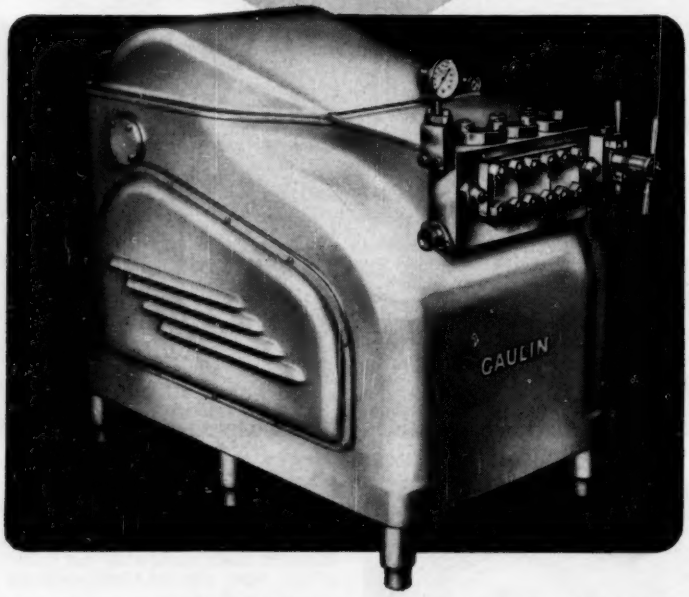
TEFLON ROD: Lengths to 6 ft. in nominal rod sizes 3/16″ to 1/2″ in 1/16″ increments; 1/2″ to 1¼″ in 1/8″ increments; 1¼″ to 2″ in 1/4″ increments.

Ask your nearest Belmont Distributor for a complete stock list. You will find him in our insert in the Packing Section of Conover-Mast Purchasing Directory.

The Belmont Packing & Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

BELMONT

Gaulin Homogenizers
Plus G.T.A.*
Unlock the Secret to Cost Savings in Blending, Dispersing or Emulsifying



Gaulin Homogenizers and Dispersers reduce ingredients down to their ultimate particle size . . . disperse them evenly. They make uniformly finer emulsions of maximum stability. Also produce fine uniform dispersions with exceptionally low rise in temperature. They give you control of particle size and viscosity . . . improve texture . . . stop color separation.

*Gaulin Technical Assistance provides free technical data, experienced advice and laboratory analysis. Take advantage of G.T.A. Write for bulletins: Homogenizers H-55, Sub-Micron Dispersers SMD-55, Colloid Mills C-57.



GTA Bulletins



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Try Particle Control in Your Plant . . . Rent a Gaulin Laboratory Homogenizer for Only $75.00 Per Month! This versatile machine reduces ingredients in your product to ultimate particle size. Minimum sample one pint; Capacity 15 GPH; Pressures up to 8000 psi. Rental costs applicable against purchase price. Write for Bulletin LH-55.

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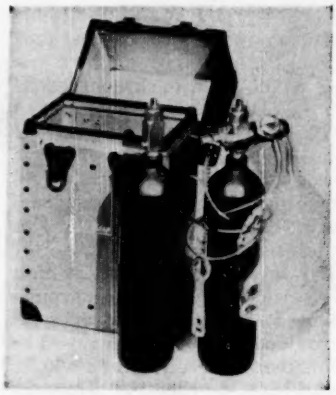
71 Garden Street **Everett 49, Mass.**

World's largest manufacturer of stainless steel reciprocating, rotary, pressure exchange pumps; dispersers, homogenizers and colloid mills.

system. Control is maintained electronically to give true process temperature over total instrument range without limiting stops.

Instrument is available with either time proportioning or on-off control, with or without anticipating section. Control stability is ± 0.5 F. for on-off model with anticipation, better with proportional model. Indication accuracy is ± ½% of scale range.

Model has plug-in plastic encapsulated circuitry. Rugged construction permits exposing the controller directly to shock, vibration, dust, and moisture.— **Electronic Processes Corp., San Francisco, Calif.** **169B**



Oxygen Mask System

Self-contained unit is lightweight and compact.

Pocketaire, new safety mask system, offers protection against breathing hazards encountered in fire fighting. Unit uses two oxygen cylinders with full or half-face leakproof masks, weighs from 4½ to 9 lb. depending on the amount of oxygen carried on special harness.

Three sizes of oxygen cylinders have 5, 15, and 25 min. working lives. Each is used with a second 5 min. escape cylinder which supplies the operator when he is returning to safety after the working cylinder is empty. Unit can be adapted to fit under fire-resistant suits or hoods. For rescue work and resuscitation, a medi-

REPUBLIC VECTOR CONTROLLERS FEATURE 2 TO 500% PROPORTIONAL BAND ADJUSTMENT

Rockwell-Built Republic vector controllers feature easy proportional band adjustment from 2 to 500%, an adjustable reset rate from 0.1 to 50 repeats per minute and less than 0.05% dead band.

This is typical of the performance of Republic's new Null-Balance-Vector line of pneumatic instruments which includes:

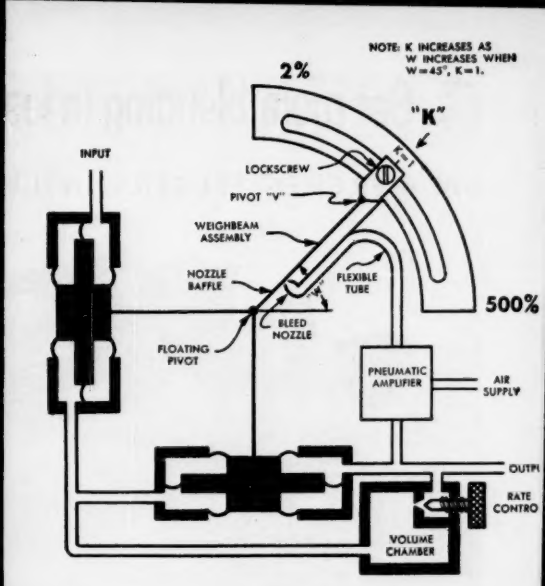
- Temperature transmitters with a 10 to 1 range adjustment.
- Pressure transmitters of 0.5% accuracy, 0.1% sensitivity.
- Differential pressure transmitters with a 20 to 1 range adjustment.
- Relays which extract square root down to 10% of output span.
- Multiplying, squaring, additive, totalizing, and ratio relays.
- Other instruments necessary for measuring, controlling, and computing variables for combustion and process industries.

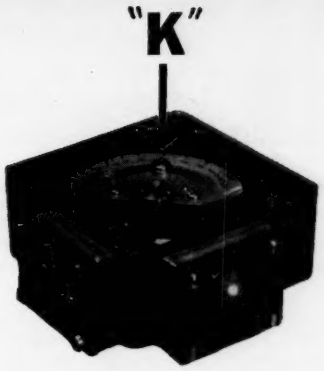
The span ("K") of each Republic Null-Balance-Vector instrument can be easily varied by loosening the lock-screw and sliding the weighbeam assembly along the slot as shown in the schematic. Zero does not have to be reset and only a comparison reference is required.

A common component, containing the "K" adjustment as illustrated, is the base around which each Republic Null-Balance-Vector instrument is built. This common "heart" means that you have interchangeability of parts—even among instruments performing different functions. Conversion and replacement parts can be pooled instead of stocking spare instruments for each control function.

In addition, you benefit from simplified operating and maintenance training because the same principle of operation is used for all instruments. All Republic Vector instruments are compact, lightweight and rugged. The Republic Engineer in your area will be glad to work with you on any control or measurement application. Or, write for information to Republic Flow Meters Company, Subsidiary of Rockwell Manufacturing Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada Ltd., Toronto.

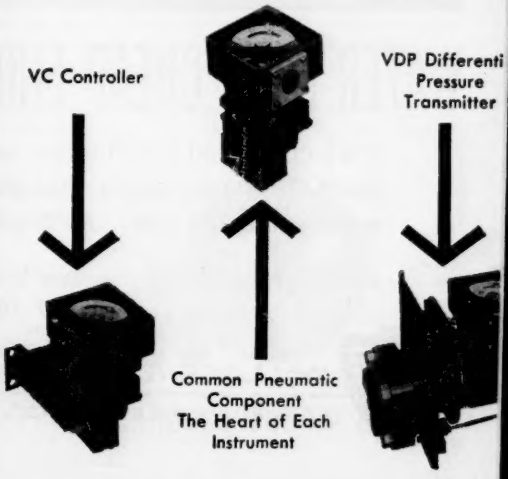
REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL





This is the common component around which eac Republic Null-Balance-Vector pneumatic instrument built. This component contains the "K" adjustment.

TYPICAL REPUBLIC NULL-BALANCE-VECTOR INSTRUMENTS



Get more blending in less space...

SIX MERCHEN FEEDERS IN 120 SQUARE FEET



Compact W&T Merchen Feeders are easy to install and operate in crowded areas—can even be ceiling-hung. Space requirements are kept to the minimum without sacrificing precise control.

W&T Merchen Scale Feeders allow more efficient use of existing plant space. Without spending money for new space, you can increase production . . . regulate yield . . . control quality. By installing Pneumatic Merchen Scale Feeders, you get centralized control as well as recording and totalizing of production.

And your product quality is insured by the minute-to-minute accuracy of these feeders . . . each formula ingredient is accurately fed by weight into your blend.

Learn how you can save space and money with W&T Merchen Feeders. Write to Dept. M-43.29

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

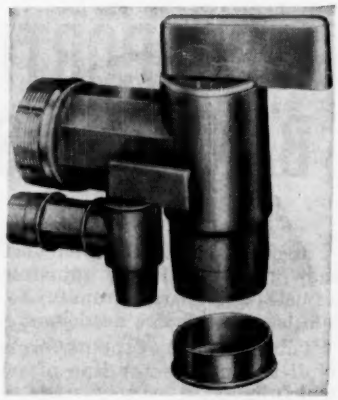
WATER ISN'T CHEAP ENOUGH TO WASTE

W&T controlled chlorination saves water and lowers treatment costs. You get maximum water value and use...even reuse.

Write for details on the new V-notch chlorinators: address Dept. S-137.29

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

cal unit is available.—**Rockwood Sprinkler Co., Worcester, Mass.** 170A



Plastic Drum Faucet

Polyethylene valve empties 55-gal. drum in 2 min.

Called Flo-King, a polyethylene drum faucet will empty a 55-gal. drum of average material in about two minutes. New faucet which fits standard 2-in. drum outlet, has patented vertical ribs inside the spout to eliminate dribble. Full flow is obtained by half-turn of the handle.

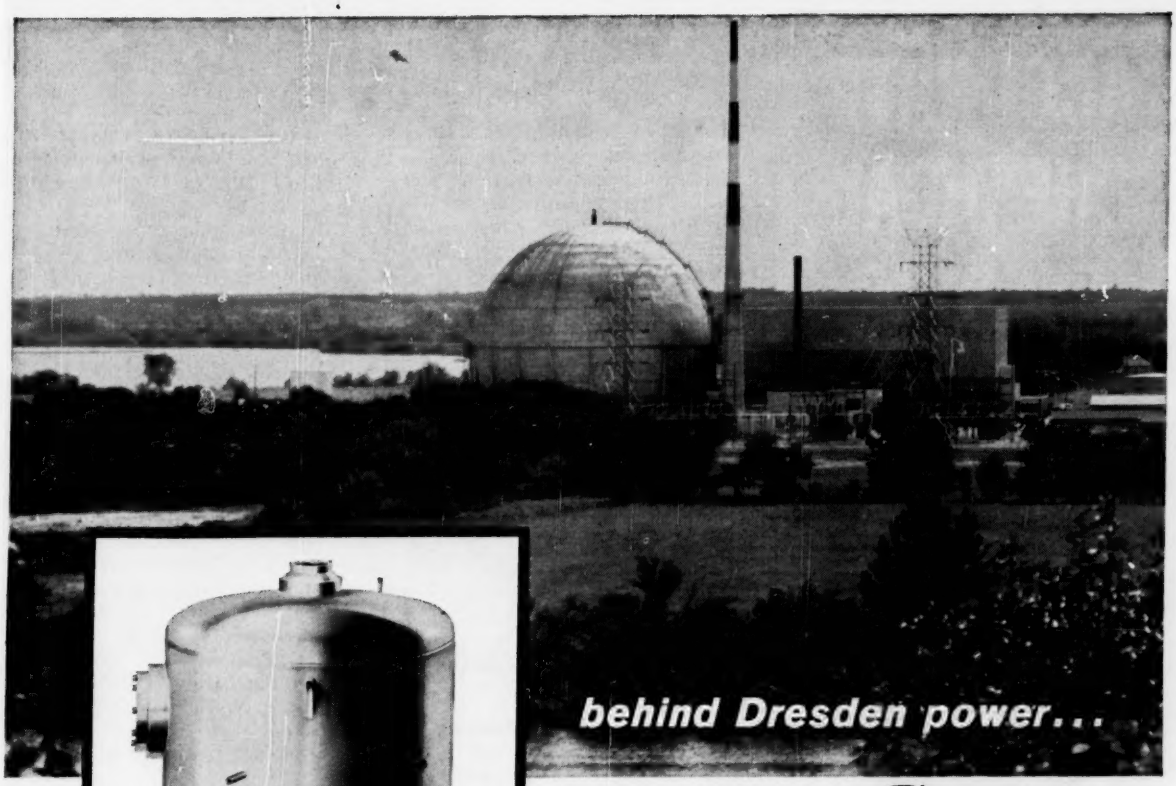
Unit comes with polyethylene spout closure to eliminate residual dripping. Manufacturer claims that faucet will handle five times the pressure exerted in a full 55-gal. drum. Pictured with new 2-in. model is ¾-in. unit previously marketed—**Multi-Meter Corp., Toledo, Ohio.** 172A

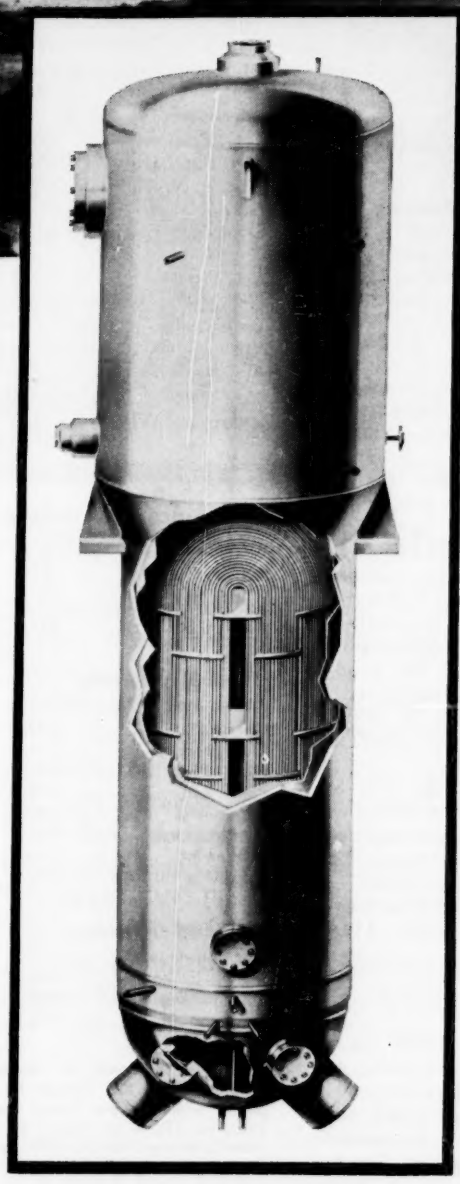
Micron-Size Filter

Removes two-micron particles from liquid or gas.

Five different filter element materials are available for a new line of general purpose filter assemblies. These include woven wire cloth, sintered bronze, resin-impregnated cellulose sheet, washers, and ribbons. Elements have pore size ratings from two to 100 microns.

Operating temperature range for the elements is—350 to 350





160,000 ft. of Carpenter stainless tubing

• First full-scale privately financed nuclear power plant in the United States is the new Dresden station near Chicago. This 180,000 kw. electric generating plant went on stream in April and will be in full operation later this year. A prime requirement in equipment for Dresden is *long-life dependability* to insure continuous trouble-free operation. A 33-year reputation for reliable performance is the major reason 160,000 ft. of Carpenter Type 304 Stainless Tubing is installed in a secondary steam generator (shown at left) in the Dresden dual-cycle reactor system with an output of 297,800 lb. steam/hr. at 500 psi and 467°F. Uniform working properties, concentricity and wall gauge of the tubing were important advantages in forming, assembling and installing the U-tube bundle in the unit.

Put the cost-saving dependability of Carpenter Stainless Tubing into your condensers, heat exchangers or other heat transfer equipment next time you re-tube existing units or build new units. Orders for Types 304 and 316 tubing in all popular heat exchanger sizes and gauges can now be shipped promptly from large mill stocks. Contact your nearest Carpenter office, representative or distributor for details and our latest Selecting and Buying Guide, Bulletin T. D. 120. The Carpenter Steel Company, Alloy Tube Division, Union, New Jersey.

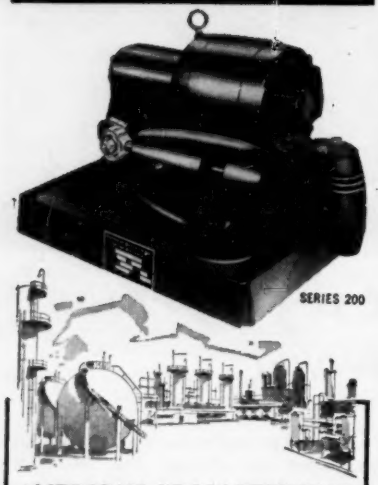
your master key to cost-savings

Carpenter

Stainless Tubing & Pipe

ACCURATE CHEMICAL FEEDING

FROM .65 gph
TO
1624 gph



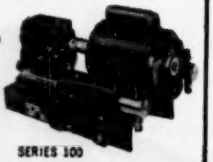
AMERICAN PROPORTIONING PUMPS have repetitive metering accuracy of ± 1% when operating between 10% and 100% of capacity. Feed precisely metered fluids or slurries in all ratios, with controlled process variables.

- interchangeable liquid ends
- spherical self-aligning bearings on crank and crosshead
- crossheads of hardened and ground steel ride on cast iron
- nylon dust covers protect bearings
- NEMA frame motors
- heavy duty reducers

Send for free bulletin.

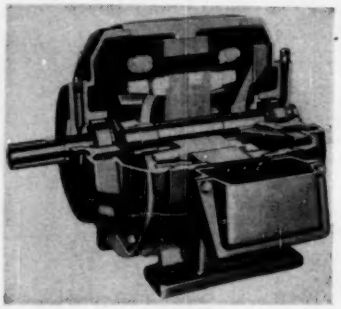
SERIES 100
Simplex models pump up to 13.10 gph at maximum pressure of 1000 psi. Duplex models double that capacity.

SERIES 200
Simplex models pump up to 812 gph at maximum pressure of 1000 psi. Duplex models double that capacity.



AMERICAN METER COMPANY
INCORPORATED ESTABLISHED 1836
pump division
13500 PHILMONT AVE., PHILADELPHIA 16, PENN.

F. Aluminum filter housings allow operating pressure of 150 psi. with burst strength of 600 psi. Filters handle fuels, hydraulic fluids, air, other gases, and liquids. — **Bendix Filter Div., Bendix Aviation Corp., Madison Heights, Mich.** 172B



Weatherproof Motor

Open-type units have encapsulated insulation.

An open motor that exceeds splash-proof motor specifications has the stator windings completely encapsulated in epoxy resin which resists water, oil, dust, acids and alkalis. The process is said to produce a uniform insulation coating which dissipates heat well while retaining flexibility and bond strength.

Resin is applied by vacuum impregnation process to wound stator core. Core is pre-heated, then vacuum drawn before resin is introduced to coat the windings. Pressure is applied with the core submerged in resin, then the whole unit is baked in a curing oven.

Available in ratings of 1 to 125 hp., motors of new line also have bearings and exposed metal surfaces protected against contaminating atmospheres. — **Reliance Electric and Engineering Co., Cleveland, Ohio.** 174A

BRIEFS

Measuring pump moves clear liquid at rates from a drop to a pint/min. Positive-displacement motor driven pump has simple adjustment for metering exact quantities. Standard model operates on 110 or 220 v.—**Bomar Laboratories, Ltd., Chicago, Ill.** 174B

Circuit breaker, 40% smaller, provides short circuit protection for electric motors. Available in current ratings up to 100 amp, breaker has adjustable magnetic trip which can be set just above start-up current surge to prevent unnecessary tripping.—**L-T-E Circuit Breaker Co., Phila., Pa.** 174C

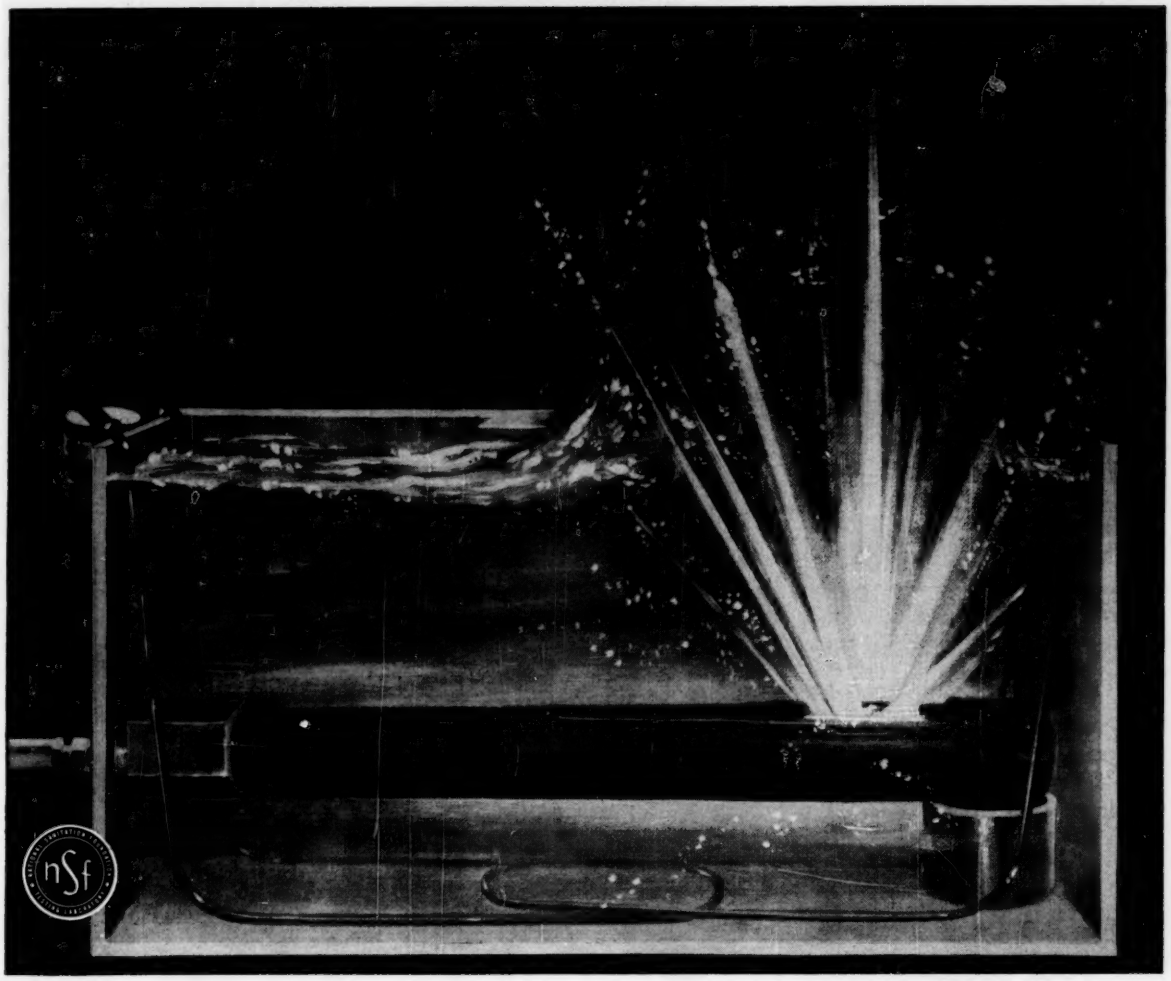
Polyethylene gloves are air- and water-tight, may be worn on bare hand or over other gloves. Five-fingered gloves come in one universal size, are thin to preserve "feel" of objects being handled.—**Olympic Glove Co., Inc., New York, N. Y.** 174D

Reversing starters mount back-to-back to save panel space. New line is available in NEMA sizes 0, 1, 2, and 3 with either melting alloy or bi-metallic overload relays. All connections made from the front.—**Square D Co., Milwaukee, Wis.** 174E

Equipment Cost Indexes . . .

	Dec. 1959	Mar. 1960
Industry		
Avg. of all	237.0	237.8
Process Industries		
Cement mfg.	231.1	232.4
Chemical	239.0	240.0
Clay products	224.6	225.8
Glass mfg.	225.6	226.6
Paint mfg.	228.7	229.7
Paper mfg.	230.2	231.3
Petroleum ind.	233.6	234.7
Rubber ind.	236.5	237.5
Process ind. avg.	235.4	236.3
Related Industries		
Elec. power equip.	242.1	242.8
Mining, milling	240.4	241.5
Refrigerating	267.3	268.4
Steam power	223.9	224.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.



We rupture our plastic pipe so yours won't

This explosion marks the end of the short but useful life of a piece of USS National PVC Pipe. We deliberately burst it during a test with pressure that would exceed the strain of normal service.

The length of PVC Pipe was submerged in heated water; then more water was forced into the pipe until it burst. The pressure was much greater than specifications. Tests like this prove to us that the PVC Pipe we sell is more than strong enough for your job.

USS National PVC Pipe is highly resistant to corrosion from acids, alkalies, salt solutions, alcohols and other chemicals. It's easy to fabricate and join, has excellent impact resistance, and its smooth internal surface minimizes deposit build-up. USS National PVC Pipe is available in sizes from ½ inch to 12 inches in diameter, and Schedules A, 40, 80 and 120.

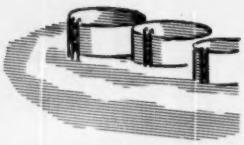
For information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. Ask for Bulletin #24. *USS and National are registered trademarks*

USS National Tube Division of United States Steel

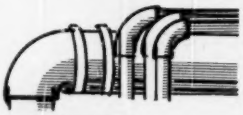
Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York

CORROSION
PROBLEMS IN . . .

TANKS AND TANK TRAILERS?



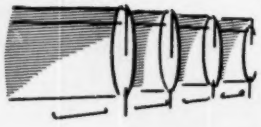
PROCESS PIPING?



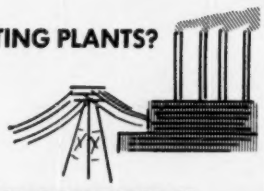
STEEL AND CONCRETE IN PROCESS AREAS?



CHEMICAL SPILLAGE?



GENERATING PLANTS?

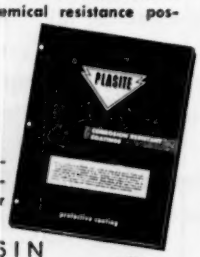


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TECHNICAL BOOKSHELF

Application of Plastics

Edited by Herbert R. Simons. Reinhold Publishing Corp., New York

Polyester Resins

By John R. Lawrence. 251 pages.....$5.75

Acrylic Resins

By Milton B. Horn. 184 pages.....$4.50

Metallizing of Plastics

By Harold Narcus. 208 pages.....$5.50

Three new additions have been made to this series* devoted to guidance in application of plastics. Most of the books deal semi-technically with the chemistry and application of a single plastic or family of plastics. Presenting the complex commercial field of plastics in small, clearly-marked doses, the series makes it a simple job to find quick up-to-date answers to questions on most aspects of the industry.

The new books tick off: polyester resins—curing mechanisms and manufacturing, techniques used in processing the resins for use in reinforced plastics, casting and coating applications; and acrylic resins — cast products, molding compounds, emulsion and solution compounds.

A few books in the series describe fabrications of plastics, for example, the third new addition which is on metallizing plastics. It describes the copper film process, the deposition of "electroless" nickel coating, a review of new molded conductive plastics, gas plating, the deposition of thick evaporated film, and other methods.

Each book is authored by a working industrial expert in the particular field. Lawrence, author of the book on polyesters, is product manager, plastics, with Glidden. Naturally enough, he includes a well-developed chapter on coatings, a relatively new use for polyester resins. Another chapter gives emphasis to formulating resins for special properties such as weathering and flame resistance.

Milton B. Horn, author of the book on acrylics, is group leader, acrylic research and development, Catalin Corp. of America. He covers current and future developments in terms of potential use in a great variety of products.—FA

* See *Chem. Eng.* Aug. 25, 1958, p. 160.

MORE NEW BOOKS

CORROSION DATA SURVEY. 1960 edition. By G. A. Nelson. Shell Development Co. $50.

CHEMICAL PERIODICITY. By R. T. Sanderson. Reinhold. $11.75.

ENGINEERING THERMODYNAMICS. By J. B. Jones & G. A. Hawkins. Reinhold. $8.50.

CONCEPTS OF THERMODYNAMICS. By E. F. Obert. McGraw-Hill. $11.

THE NATURAL PIGMENTS. By K. W. Bentley. Interscience. $5.

MOLECULAR STRUCTURE. By J. C. D. Brand & J. C. Speakman. St. Martin's Press. $8.



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Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

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No valves, pistons, or vanes.

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Saves floor space.

Desired delivery temperature Automatically maintained.

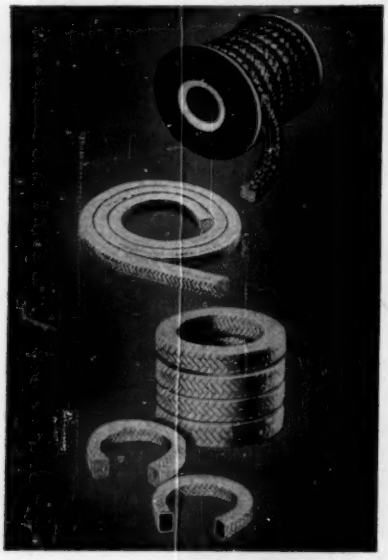
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

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Write for revised Bulletin CP-552.

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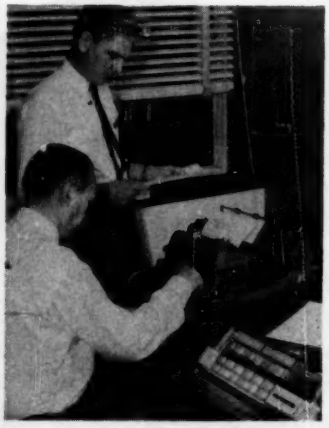
CHEMICAL & POWER PRODUCTS, Inc.

5 Broadway, New York 4 N. Y.

PEOPLE...

LETTERS: PRO & CON

C. H. CHILTON



Pro: Visual Presentation

Sir:

Thank you for the tearsheets on the Pritchard-LGP-30 story (May 16, pp. 78-80). You certainly did a great job in putting both the chemical engineering and computer mathematics phases of the story in proper focus. It's not easy to blend the technical details of two distinct scientific methods into a clear, readable story.

Your art department deserves a special pat on the back for the excellent illustration of the track-sharing concept. It not only clarified what was being done but accentuated the value of the technique in utilizing the hidden computer capacity.

AMBROSE WALSH
Burson-Marsteller Associates
New York, N. Y.

Pro: Easy Filing

Sir:

I was just about to let my subscription expire, but the last issue that arrived interested me in one important respect. You had at last achieved a magazine bound without staples and with the articles so organized that the busy engineer thumbing through the magazine could easily tear out the articles he wished to retain in his files.

This means I can keep the articles I want in my files, glance at the rest and get rid of it. My wife gets pretty annoyed over stacks of unfiled magazines around the house.

Congratulations, and keep it up.

G. E. SMALLEY
Long Beach, Calif.

Fine Grinding Process

Sir:

In the feature article, "Hydrogen's Revolutionary Role," in your Nov. 16, 1950, issue, reference is made on p. 181 to a new pulverization process. Can you tell us where to find a description of this process?

JOHN THORNBERRY
Kaiser Aluminum & Chemical Corp.
Permanente, Calif.

Sir:

While developing the Texaco coal gasification process, a fine-grinding procedure was developed which is applicable to the pulverization, not only of coal, but of many other materials, such as limestone, talc, sawdust, ores and many metals.

This grinding process has been conducted on a commercial scale, pulverizing an impure and relatively hard talc. Particle size of the product, depending on the raw material, averages from 1 to 10 microns. In the case of certain materials, the particle size can be reduced further by additional processing.

In essence, the process comprises coarse-grinding the material to a particle size suitable for slurrying with a liquid, pumping the liquid through a heater and thence through a specially designed grinding device. The ground material is recovered from the slurry medium by separation and classification.

If Mr. Thornberry (or any other reader) is concerned with an operation or project that involves extremely fine pulverization in substantial quantities

Some Straight Talk On Steam Trap Capacity

...or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counterclaims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

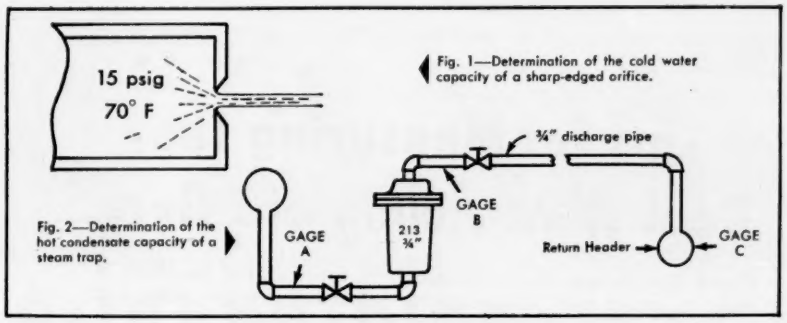


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hookups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8582 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS



Fl[illegible]id snubs against ob-
je[illegible]id grips where round-
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have large, deep-broached
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provides non-slip action.

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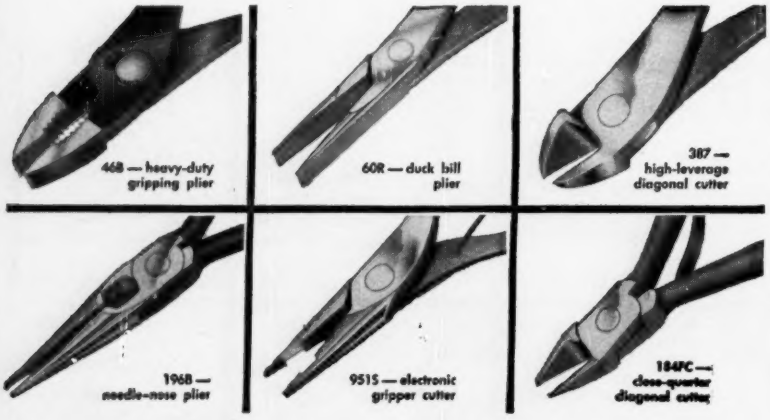
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PRO & CON . . .

(i.e., 100 or more tons/day), I suggest he write us, giving such information with respect to the material as would be necessary for us to advise him whether or not our process is applicable to his grinding problem. Such information would comprise the nature, including composition and size distribution, of the material to be ground, its hardness, its chemical composition, particle size and size distribution desired, etc.

Upon receipt of such information, we would be glad to comment with respect to the applicability of our process, together with the probable approximate cost of an installation and an estimate of operating requirements.

WYNKOOP KIERSTED, JR.
Texaco Development Corp.
New York, N. Y.

Pro: Unionized Thought

Sir:

Mr. Tsang, in your May 16 issue (p. 216), suggests that unions of engineers and scientists have little real power, since they could not carry out an effective strike.

But strikes are not the only answer. It certainly seems that the only way to fight some unreasonable management practices is to present a "unionized thought."

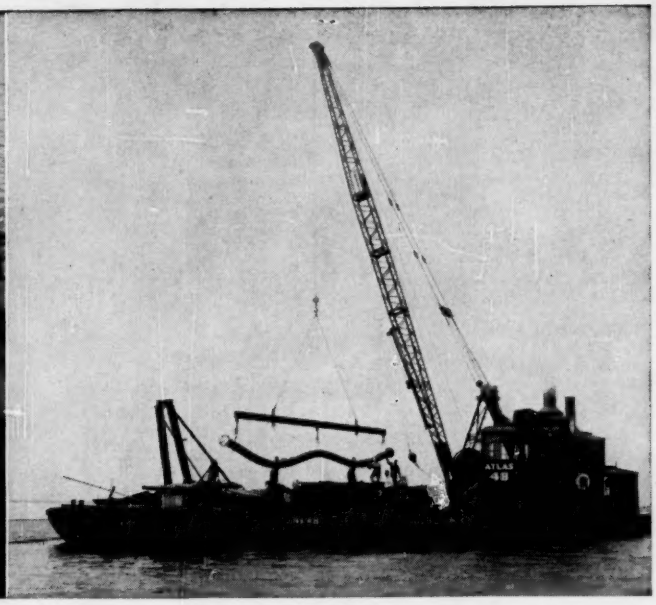
For instance, my present employer has the darndest policy of having you sign a contract that for a period of three years following termination of your employment, you should not use your experience gained while employed. My employer goes as far as telling your new employer —after you quit or get fired— about that undemocratic contract. (Russia has similar procedures; you can't quit unless your boss agrees.)

Let's stop kidding ourselves. Management won't pay attention unless we all speak up. And since we're doing so little through ACS and AIChE, professional unions will eventually become the only answer.

Please withhold my name.

RESEARCH ENGINEER
Texas City, Tex.





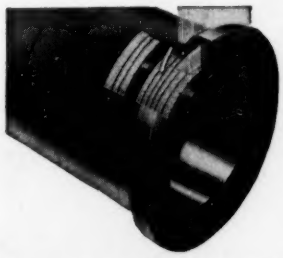
CONDOR RUBBER PIPE used for

Largest Under-Water Waste Disposal System

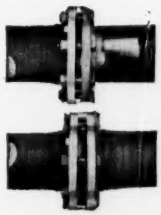
A large chemical plant has installed 1864 feet of 12″ diameter Condor Flexible Rubber Pipe in the lower Delaware River to discharge process wastes from shore to the river channel. Condor Rubber Pipe provided flexibility to permit bolting 50′ lengths together on the deck of the dredge and laying them into a trench in the river bottom. This was easier than bolting or welding a metal pipe-line under water . . . and the rubber pipe will last longer than metal against salt water corrosion outside; nitric and sulfuric acid wastes inside.

Condor Flexible Rubber Pipe outlasts steel 3 to 10 times. It is made in types to withstand pressures up to 250 psi. Installation is easy, economical—and there's no danger of leaky joints at pipe bends. New Hydro-Lok built-on flanges offer full sealing surface *plus* advantage of sure alignment and easy rotation of pipe to equalize wear—*without* removing flange bolts.

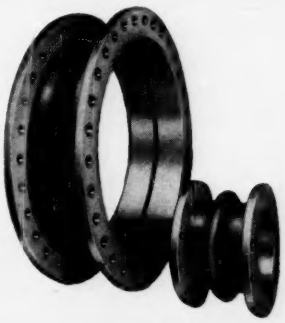
Let an R/M representative give you details on Condor Flexible Rubber Pipe . . . or write today for Bulletin 7152.



- Steel Pressure Ring molded into Hydro-Lok Flange
- Thick, corrosive resistant tube
- Multiple plies of heavy duck
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- Tough durable cover



Hydro-Lok Flanges may be used with equal ease to couple rubber pipe to iron pipe with standard flanges (top) or existing sections of rubber pipe using other flanges.



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E. M. FLYNN

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Chemicals

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139a *Union Carbide Chemicals Co.

Blowing Agent.....Booklet details manufacturers claim of advantages in using "Genetron" halogenated hydro-carbons as blowing agents for rigid urethane foams.
186A General Chemical Div.

Catalysts.....Facilities for producing carload quantities of performed catalysts to fit special process requirements. Booklet, "Harshaw Catalysts" is offered.
87 *The Harshaw Chemical Co.

Caustic Potash.....available in 6 forms. New technical Bulletin 15 is crammed with facts, tables, diagrams for applying caustic potash. Send for your copy.
83 Allied Chem., Solvay Process Div.

Chemicals.....Sections on acrylamide, intermediates, fibers, plastics, polymers, surface coatings, and physical studies are included in 20 pages of notebook sheets.
186B American Cyanamid Co.

Chemicals.....Methyl Glucoside, Polyoses, Zein, Glucuronolactone, Inositol, Phytic Acid, Sodium Phytate, and dextrose derivatives, all products of corn, are briefly described.
186C Corn Products Division

Chemicals.....The 1959 Physical Properties of Synthetic Organic Chemicals . . . a comprehensive description of properties & applications of over 400 chemicals.
139b *Union Carbide Chem. Co.

Coagulant Aids.....described in new bulletin, are used in municipal & industrial water systems, waste waters, cold & hot process softening, oil field waterflooding, etc.
93-94j *U. S. Industrial Chemicals Co.

Cryogenic Gases.....Available both as a chart and a wallet-sized card, the data supplied includes boiling, critical, and triple points, specific heats, and densities.
187A Air Products, Inc.

Diatomaceous Silica.....Applications to the portion of the paper industry dealing with groundwood, sulphite, and soda pulp papers, and various molded papers is covered.
187B Great Lakes Carbon Corp.

Diatomite.....Each grade of Celite diatomite has its own distinctive particle size distribution. Assistance with specific filtration or mineral problems is available.
163 *Johns-Manville

Dispersants & Inhibitors.....have been developed to prevent formation of sludge in fuel oils. Dispersants are dialkyl dimethyl ammonium chlorides. No. 1607.
93-94l *U. S. Industrial Chemicals Co.

Dodecenyl Succinic Anhydride..... Tech. bulletin outlines physical and chem. properties plus suggested uses for material that contributes unusual properties to epoxy resin.
187C National Aniline Div.

Dyes.....Separate chapters in this 86-page book are devoted to each of the most important man-made textile fibers presently available commercially and their blends.
187D Dyestuff and Chemical Div.

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93-94f *U. S. Industrial Chemicals Co.

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93-94a *U. S. Industrial Chemicals Co.

Extruded Plastic.....A 72-page book has a complete discussion of extruding including the new practice of imbedding metal strips in the extrusion. A sample is enclosed.
187E Anchor Plastics Co.

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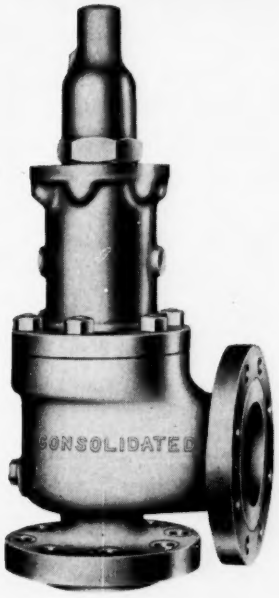
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saves



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The Sealing Bellows and "O" Ring Seat Seal are typical of the extra quality built into Consolidated Safety Relief Valves to assure absolute protection for personnel and plant. These fine features plus flat seating and single ring construction also eliminate many maintenance problems and costs. Write for Catalog 1900 and Bulletin 1940.

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IN YOUR PLANT...

STOP THESE 10 LOSSES WITH NEPTUNE *liquid* METERS

1



STOP SPOILED BATCHES Get automatic formula control with Auto-Stop meters.

2

STOP WAITING for liquids to creep up to gauge mark. Let the meter do it!

3

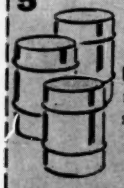


STOP MANPOWER LOSS hauling buckets or bags. Meters do the measuring while pumps do the work.

4

STOP GIVING AWAY INGREDIENTS by over-measurement just to be sure.

5



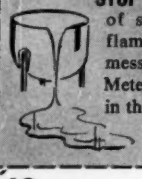
STOP BACK CHARGES for rejects. Meters save customers.

6

STOP GUESSING COSTS. With meters you always *know.*

7

STOP HAZARDS of spilled inflammables or messy liquids. Meters keep 'em in the pipe.



8

STOP RECEIPT LOSSES. Meters *prove* any shortages.

9



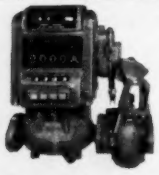
STOP SHIPPING LOSSES Meter - printed tickets give proof of honest delivery from your plant.

10

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188A Armour Industrial Chemical Co.

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12-13 *Enjay Chemical Co.

Handling of Chemicals.....Health factors in safe handling of chemicals is subject of first in series of pamphlets on safety, to be sold at nominal cost by MCA. No. 1602.
93-94g *U. S. Industrial Chemicals Co.

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188B Sun Oil Co.

High Alloy Castings.....Booklet lists 46 technical papers, articles, reprints and data sheets available on stainless and heat resistant castings.
188C Alloy Casting Institute.

High Purity Gases.....A general survey of the rare gases, radioaotive gases, properties and uses of the rare gases, and nuclear applications of radioactive gases is given.
188D Linde Co.

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Isocyanates ..... Booklet describes proper handling and storage requirements. Explains best methods of unloading and recommends temperature and moisture control.
188F National Aniline Div.

Microporous Polyethylene Films.....A technique has been developed for producing extremely fine, uniform, interconnecting pores in polyethylene films.
93-94d *U. S. Industrial Chemicals Co.

Molecular Sieves.....are always uniform, with high capacity, high strength, and high bulk density. Available in regular & special grades to meet specifications. Facts.
89 *Linde Co., Div. of Union Carbide

Olefin Plants.....Information about Kellogg's 2-billion-pound background in engineering and/or building ethylene plants, contained in "Olefin Plants" Kelloggram.
37 *The M. W. Kellogg Co.

Polyethylene.....in powder form is a new development for coating metals, textiles, paper, glass, etc. Described in a technical data bulletin now available. No. 1600
93-94e *U. S. Industrial Chemicals Co.

Polyethylene Extrusion.....A highlight of the recent American Chemical Society meeting in Cleveland was this paper on current developments by Mr. F. R. Tittman.
188G Union Carbide Plastics Co.

Proteins.....40-page booklet describes numerous uses for both alcohol-soluble protein and mild aqueous alkali dispersible protein. Present and projected uses given.
188H Corn Products Div.

*From advertisement, this issue

LITERATURE . . .

Resins.....Designed as a protective surfacing for wood products, diallyl phthalate resin is discussed in relation to its papers, core materials, and release agents.
189A Dapon Department, FMC Corp.

Resins.....A new fluorine-containing thermoplastic resin, called RC-2525 is announced in this 16-page color description covering structure, properties, and performance.
189B Pennsalt Chemicals Corp.

Sodium Aluminates.....This 12-page booklet outlines uses in the chemical processing, cement, detergent, glass, paint, pharmaceutical, paper, rubber and textile industries.
189C Nalco Chemical Co.

Sodium Dispersions.....Many types of sodium dispersions are now being sold commercially by several companies. These firms are familiar with the techniques involved.
93-94b *U. S. Industrial Chemicals Co.

Sulfuric Acid.....Information offered on service & facilities for sulfuric acid users with problems of handling & disposal of large quantities of sulfuric waste materials.
59 *Allied Chem., Gen. Chem. Div.

Titanium.....A "titanium facts" folder lists the types of titanium and alloys with their commercial and military code numbers, metallurgical properties and other data.
189D Nooter Corp.

Urethane Foam.....Technique for producing flame-resistant urethane foam described in booklet. Property particularly useful in aircraft and transportation seating.
189E Mobay Chemical Co.

Wetting Agents.....Booklet describes surfactants in several chemical classes; some developed only for wetting ability, others with auxiliary properties.
189F Nopco Chemical Co.

Zinc Oxide.....The advantages of a zinc oxide additive to paints is strikingly illustrated by means of color photograph inserts in this water emulsion paint booklet.
189G The Eagle-Picher Co.

Zirconium Oxides.....Brochure lists materials and describes processes used in manufacturing high-temperature refractories. Plant facilities are illustrated.
189H Zirconium Corp. of Amer.

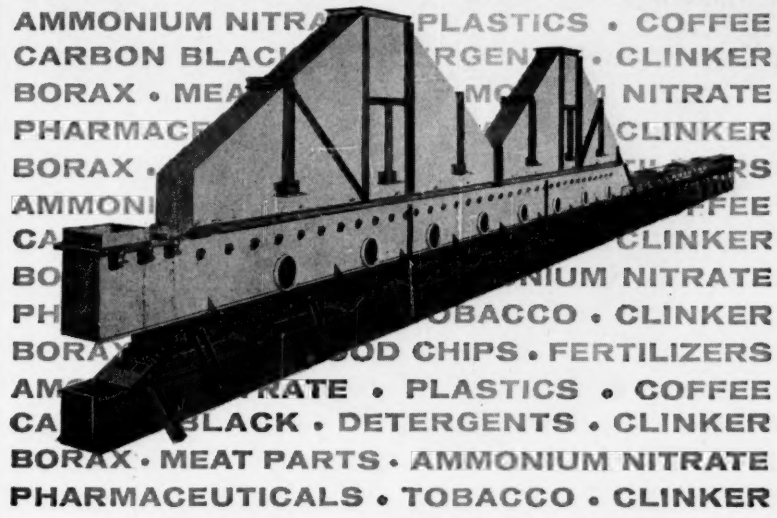
Construction Materials

Alloys.....Information about the properties and corrosion resistance of Hastelloy alloy F, contained in a 12-page booklet which is available on request.
147 *Haynes Stellite Co.

Aluminum Electrical Rigid Conduit.....needs no protective coating, because it forms its own—an oxide film that repairs itself when damaged. Full details.
10-11 *Rome Cable Div. of Alcoa

Coating.....The Kanigen process for chemical nickel alloy plating produces a uniform thickness of coating, regardless of the contours of a part. Bulletin 258.
81 *Gen. American Transportation

*From advertisement, this issue



HEAT TRANSFER

cooling-drying ON THE RUN!

Carrier Processing Conveyors combine conveying and processing to save space...reduce costs...increase capacity...protect products.

The conveyor shown above dries, screens and conveys carbonaceous particles at the rate of over 2 t.p.h. Moisture is reduced from 14% to ½% using 350° F. air in just the first 30 feet. Material is conveyed a total of 80 feet.

HERE'S WHAT CARRIER "CUSTOM ENGINEERED" CONVEYORS CAN DO FOR YOU

SAVE SPACE...require less headroom ...can elevate material as well as straight-line convey. Simple accessories make possible additional operations such as screening...lump breaking...sampling.

REDUCE COSTS...double-duty Carrier Conveyors eliminate need for multiple units. Operating and maintenance costs are far lower than for other types of process equipment.

INCREASE CAPACITY...size for size... job for job. Carrier Conveyors assure maximum capacity and greater return on your investment.

PROTECT PRODUCTS...gentle Natural Frequency conveying action protects fragile crystals or pellets. There is no product breakdown...no segregation. Simple, easy-to-clean troughs keep food and pharmaceuticals contamination-free.

Carrier laboratories will provide test data on your materials. Write Carrier Conveyor Division, CHAIN Belt Company, 214 North Jackson Street, Louisville 2, Kentucky.

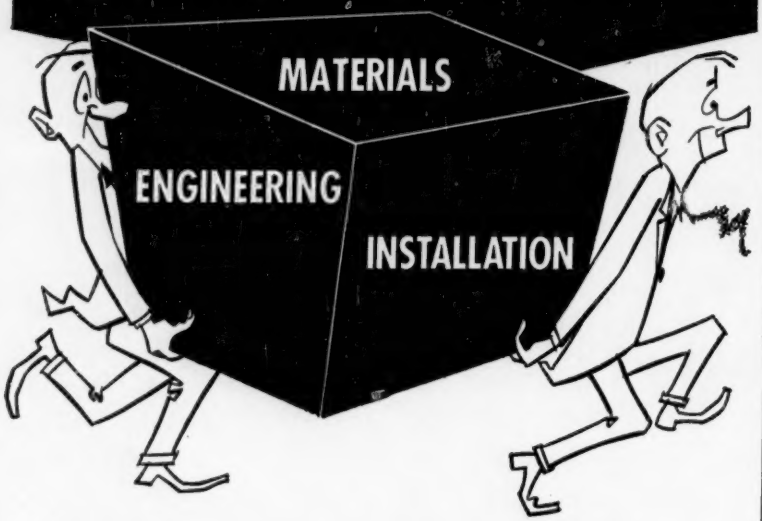
CARRIER CONVEYOR

NATURAL-FREQUENCY® VIBRATING EQUIPMENT

CHAIN BELT COMPANY

CONVEY • FEED
DEWATER • SCREEN
COOL • DRY
SCALP • COAT
DISTRIBUTE • ELEVATE

CEILCOTE OFFERS THE ONLY COMPLETE PACKAGE CORROSION-PROOFING SERVICE



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6823-OC

Now you can consolidate contracts . . . concentrate responsibility for corrosion-proofing service . . . save time and money! Ceilcote's "Complete Package" gives you the benefit of Ceilcote's extensive facilities plus 33 years of experience in developing, producing and installing corrosion resistant facilities. Working under contract, experienced Ceilcote engineers and competent installation crews handle all your problems and *guarantee job satisfaction!* Typical successful installations include flooring, tank linings, foundations, pits, piers, waste disposal systems as well as all types of Duracor reinforced plastic process equipment and ventilations systems. Write for complete information or call your nearest Ceilcote Sales Representative.

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CANADA: OTTAWA CE. 3-7785.

CEILCOTE

THE CEILCOTE COMPANY INC.

4836 Ridge Road • Cleveland, Ohio

Coating.....Plasite is the solution for immersion service, where high temperature, splash, spills, and fumes are severe, & in many formulations for corrosion protection. Bul.
176 *Wisconsin Protective Coating Co.

Condor Flexible Rubber Pipe.....is made in types to withstand pressures up to 250 psi. No danger of leaky joints at pipe bends. Details in Bulletin 7152.
181 *Raybestos-Manhattan, Inc.

Fabricating.....Whatever your plate needs the staff & facilities to take care of them is available. Booklet describes plate fabricating & construction services.
6-7 *Amer. Bridge Div., U. S. Steel

Insulation.....Bulletin describes companies complete line of adhesives, coatings and weatherproofing for the commercial and industrial insulation field.
190A Insul-Coustic Corp.

Insulation.....U200 new low temperature insulation handles jobs in —300 F. to +220 F. range. Complete engineering specifications & other details in Bul. U200-1.
31 *Union Asbestos & Rubber Co.

Linings.....Permobond linings can be applied to existing as well as new equipment. Authorized Permobond Service is available. Information on request.
151 *United States Rubber

Packings.....Chempro Braided Teflon packings available in all sizes in standard 1/16" increments from ⅛" to ¾" square in spool or coil forms. Rev. Bul. CP-552.
178 *Chemical & Power Products

Plastic ..... Ryertex - Omicron PVC offers outstanding resistance to 281 corrosive solutions & gases. It is immune to weather, rotting & aging. PVC Bulletin 80-3.
104 *Joseph T. Ryerson & Son, Inc.

Platinum Metals.....in all shapes and forms . . . sheet, strip, foil, wire, tubing, gauze, salts and chemicals. Clads & composites also available in many forms. Bulletin P-6.
73 *J. Bishop & Co.

Silicone Rubber.....Booklet describes applications of room temperature vulcanizing liquid silicone rubber family and highlights outstanding properties.
190B General Electric Co.

Stainless Steel.....Structure and phase changes in steel alloys at high temperatures are explained and the applications of the sigma are discussed in 8 pages.
190C Electric Steel Foundry Co.

Stainless Steel.....promises long life and low maintenance. Offers outstanding corrosion resistance & is easy to clean. Information about Stainless Steel cyclones offered.
14-15 *U. S. Steel

Tank Linings.....Gar-Line Penton Tank Linings offer high temperature protection against corrosion. Data on Penton & information on Teflon Anti-Stick.
211 *Garlock Inc.

Thermal Insulation.....The "economic thickness" approach to specification of nsulation is used in relation to other considerations in a 16-page full-color booklet.
190D National Insulation Mfrs. Assn.

* From Advertisement, this issue

Wire Cloth.....from any metal or alloy including titanium. In nine basic weaves, from finest to coarsest mesh. Fill your most diversified bulk wire cloth needs. Catalog. **44** *The Cambridge Wire Cloth Co.

Zinc Dust.....is now being used as a reducing agent, precipitating agent, purifier, catalyst, polymerizing agent, & in rust-resistant paints, bleaches, etc. Information. **50** *American Smelting & Refining

Electrical & Mechanical

Motors, AC.....This motor selector also contains listings of horizontal-shaft and right-angle gearmotors, coupled-unit speed reducers, generators and bench grinders. **191A** Howell Electric Motors Co.

Motor Control Centers.....Bulletin SM-244 gives detailed information on all the "plus" advantages you get when you specify these motor control centers. **75** *Square D Company

Motor-Starter Combinations.....polyphase open-type, totally-enclosed, or explosion-proof motors and magnetic increment starters. Bulletins MU-128 and MU-195. **199** *Wagner Electric Corp.

Motors.....Varidrive Motors are available in ratings: ¼ to 75 H.P. One compact, self-contained unit. Color-brochure is offered. Bulletin No. 1797. **213** *U. S. Electrical Motors, Inc.

Motors, AC.....In addition to a motor selection section, information on special mountings and other modifications is included in this complete 56-page listing of motors. **191B** Sterling Electric Motors, Inc.

Thermocouple Wires.....tremendous variety available. Dependable quality control assured. See full line by requesting Wire Bulletin 32WS-4 which is now available. **T208** *Thermo Electric Co., Inc.

Turbines.....with a totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing & bearings, etc. Further facts Cat. 200. **143** *Coppus Engineering Corp.

Handling & Packaging

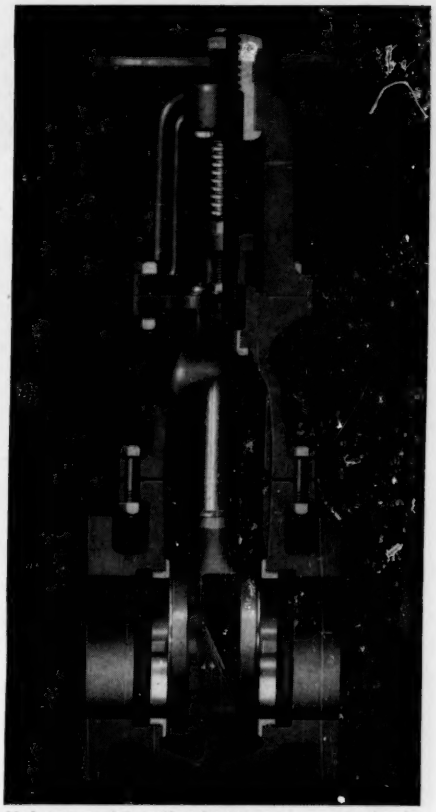
Feeders.....Merchen Feeders are easy to install and operate in crowded areas . . . can even be ceiling-hung. Details on Merchen Feeders and new V-notch chlorinators offered. **172** *Wallace & Tiernan Inc.

Flexible Packaging....The Compak line of packaging machines shows its versatility in type of feed and packaging material in this full-color 8-page booklet. **191C** **Hayssen Manufacturing Co.**

Gas Supply Trailers.....with manifold & controls for your gas & handling requirements. Cylinders, safety Devices, Controls, etc., in accordance with ICC requirements. **T210** *Independent Engineering Co.

* From Advertisement, this issue

For severe corrosive conditions specify ALUMINUM GATE VALVES by Darling



Unique revolving disc feature assures maximum life under the most exacting service conditions. Friction between wedges is reduced to a minimum. Horizontal and vertical equalization of wedging pressure is assured.

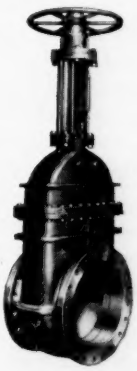
Handling corrosive chemicals such as hydrogen peroxide, ammonium nitrate, acetic acid, concentrated nitric acid? Darling Aluminum Gate Valves give you longer life, cut maintenance costs, under these and other severe service conditions. Here's why:

Darling metallurgical engineers have thoroughly tested and standardized on the most highly corrosion-resistant aluminum alloys in use today.

Accurate casting control and precision assembly reduces friction and wear, provides maximum ease of operation.

Darling Double Disc Parallel Seat principle assures freedom from leakage, trouble and downtime.

Darling aluminum alloy valves are available in sizes from ½" through 24". Write us about your requirements and service conditions.



DARLING VALVES

DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



NEW!

LECTRODRYER® BUDGET AIR DRYER

supplies small quantities of dry air at low cost

If your requirements for very dry air are relatively small—but highly important—you'll find the new Budget Air Dryer tailor-made for your needs. An investment in large equipment is not needed. The Budget Dryer is modestly priced, easily installed and serviced, operates on any 110 volt a.c. line.

NEW BUDGET DRYER IS IDEAL FOR:

- air-operated instrument controls
- electronic equipment
- small cubicles
- pilot plant operations

This entirely new unit supplies up to 20 cubic feet per minute of air, dried to a dewpoint of −60°F or lower. Operation is completely automatic. Likewise, the unit is as foolproof as possible, operating independently of variations in air pressure. Rugged construction and a long operating cycle assure trouble-free use.

Lectrodryer Budget Dryers are standard units, available from stock, shipped ready for installation. For complete information on this new unit and its low cost, write for Bulletin B6A, Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd St., Pittsburgh 30, Pa.

Lectrodryer McGRAW EDISON

LITERATURE . . .

Materials Handling . . . . . "Payloader units are available up to 12,000 operating capacity. Literature entitled, "Industrial Materials Handling the Payloader Way" available.
47 *The Frank G. Hough Company

Plastic Bags.....In a space 10 ft. by 20 ft. by 30 ft. a bag plant makes finished, printed bags from resin granules, described in a 4 page, full-color folder.
192A F. J. Stokes Corp.

Proportioning System.....Select-O-Weigh incorporates such units as feeders, scales, controls and read-outs. Full details on how you can automate your processing.
193 *Richardson Scale Co.

Weigh-Feeding Equipment.....Waytrol automatically proportions & feeds raw materials. Catalog 941 describes this automatic weigh-feeding equipment.
32 *The Jeffrey Mfg. Co.

Heating & Cooling

Boilers.....Vapor Modulatic water tube boilers furnish high or low-pressure steam (at design pressures up to 1000 psi, or even higher). Bulletins offered.
195 *Vapor Heating Corp.

Centrifugal Fans.....76-page booklet describes complete line of fans with flat, backwardly inclined blading suitable for a number of industrial uses.
192B Westinghouse Sturtevant

Film Type Exchangers.....are used as Coolers, Condensers, Absorbers, Heaters, & Evaporators. Bul. HE-8 describes unusual & standard heat transfer equipment.
125 *Henry Vogt Machine Co.

Generators, Inert Gas.....offer precise fuel control & automatic safety. If you need inert gases for blanketing, purging & protective uses, see Bulletin L-10.
91 *The C. M. Kemp Mfg. Co.

Heat Transfer.....New Multi-Zone Plate-coil offers operating pressures up to 250 psi in all kinds of tank and process heating. Bulletin P 61 for more data.
131 *Tranter Mfg., Inc.

Heat Transfer Equipment.....designed, fabricated & delivered regardless of the materials required: Steel, Stainless Steel or the Nickel Alloys. Bul. No. 158-HE.
154 *Doyle & Roth Mfg. Co.

Heating Systems.....Aroclor systems deliver steady process heat. Information booklet on Aroclor 1248 heating systems and guide to heater selection offered.
165 *Monsanto Chemical Co.

Kilns.....Bulletin No. 1115 contains complete information on Kilns, Coolers and Slakers. Kilns feature operating economy, advance design and rugged dependability.
30 *Traylor Engr. & Mfg. Div.

Ovens.....Bench, Cabinet, Truck, and Conveyor types. Bulletin 127 describes the many types of ovens available for specific heat processing operations.
B208 *W. S. Rockwell Co.

*From advertisement, this issue

LITERATURE . . .

Rotary Indirect Air Cooler.....3" —6" dia. X 18' —6" long. This unit is unique in that no air for cooling is in with the product, consequently no dusting. Catalog.
B210 *Davenport Machine & Foundry

Steam Traps.....Information on trap capacity ratings, plus data on how to correctly size, install & maintain for any pressure, temp., or load. A 48-page Book.
179 *Armstrong Machine Works

Steam Traps.....operate on a true balanced pressure principle . . . they have only one moving part. Offer positive shut-off, high capacity & rigid pretesting. Catalog.
164 *W. H. Nicholson & Co.

Thermocouples..... Catalog covers base and noble metal thermocouples and thermocouple assemblies. Temperature ranges and performance specifications given.
193A Trinity Equipment Corp.

Vaporizer.....High-temp. low-pressure units range from 44,500 to 50,000 Btu/hr & operate at temp. from 350 to 750 F at pressures from 1 to 113 psi. Bul. ID-54-5.
41 *Foster Wheeler Corp.

Instruments & Controls

Analog Computer.....Described and illustrated in bulletin, newly developed computer features continuous "real time" solutions for mathematical computations.
193B Southwestern Ind. Electronics

Boiler Controls.....This new catalog describes water level controls for pressures from 30 to 1668 lb. WSP by use of engineering data, cutaway views, and sketches.
193C Magnetrol, Inc.

Computer System.....The Internal Reflux Computer System can be supplied with either pneumatic or electrical output. Components are all standard proven units. Details.
16-17 *Taylor Instrument Co.

Data Processing System.....The new IBM desk-size computer solves wide range of specialized problems. Information & complete specifications.
8-9 *International Business Machines

Data Processing System.....offers flexible process control. Information on the 123 Data Processing System or an on-stream survey is contained Data File 14-27-09.
200 *Beckman Instruments, Inc.

Electronic Computer.....A copy of Application Report #10, as well as full specifications on the compact, mobile LGP-30 available now on request.
65 *Royal McBee Corp.

Electronic Gauge.....provides complete automation in gauging liquids & solids. Measures alcohol, asphalt, flour, wood pulp, etc. Details on request.
167 *Gilbert & Barker Mfg. Co.

Gas Flow Computer.....can be used to measure mass flow of such gases as ammonia, hydrogen, ethylene & other hydrocarbon gases, as well as hydrochloric acid gas. Details.
49 *Minneapolis-Honeywell

*From advertisement, this issue



You can automate from bin to batch with Richardson equipment

Whether your requirements are large or small, a Richardson Select-O-Weigh automatic proportioning system offers you the advantages of – **1.** Savings in labor costs. **2.** Increased productivity. **3.** Quality control. **4.** Better housekeeping. **5.** Permanent printed records. Incorporated into and governed by a Select-O-Weigh System are such units as –

Feeders – Designed to handle your material quickly and quietly – hundreds in use on all kinds of products.

Scales – Richardson Automatic Scales are known for speed and dependability. Any number can be remotely controlled by a Select-O-Weigh system.

Controls – Program your production and processes by punched card, formula board, formula capsule or weight-selector verniers. Only Richardson offers all four. Control is from a single electronic panel board, operated by one man. No special training is required.

Readout–Richardson furnishes counters, totalizers, printers, typewriters and recorders of all types.

Richardson's nationwide network of service facilities is at your disposal within 24 hours if required. Likewise, Richardson helps you at start-up of your system and thoroughly checks it in operation. For full details on how you can automate your processing with Richardson equipment, write or call today. 1791

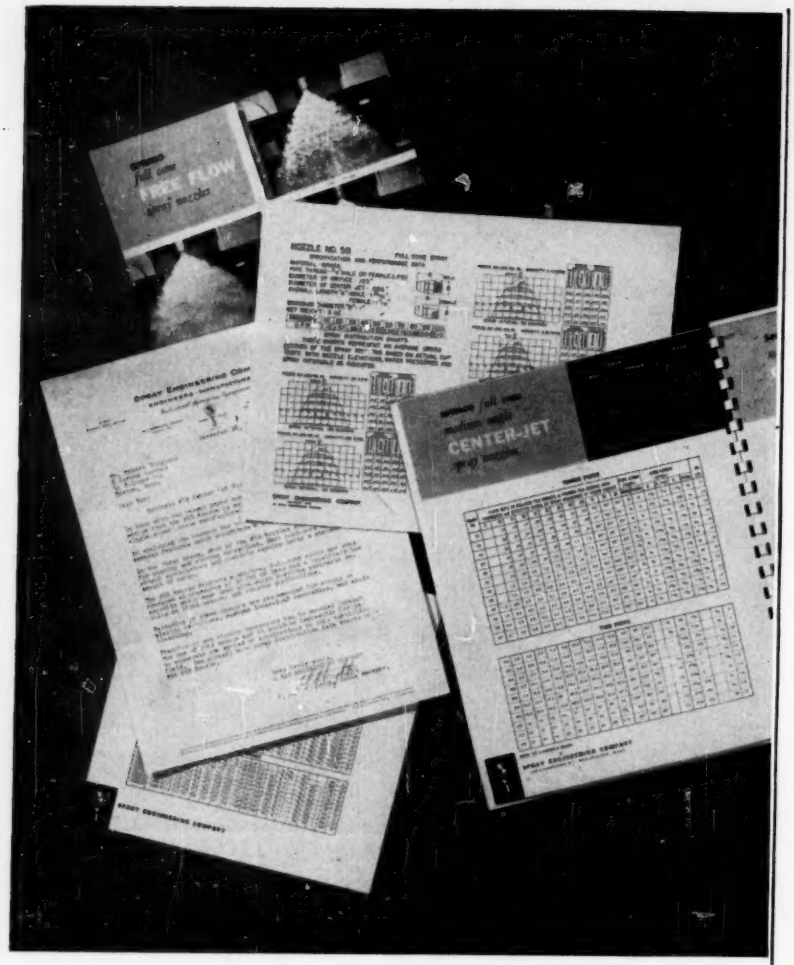
Richardson Scales conform to U.S. Weights and Measures H-44 for your protection.

Here's the answer . . .

Richardson
MATERIALS HANDLING BY WEIGHT SINCE 1902



RICHARDSON SCALE COMPANY • CLIFTON, NEW JERSEY
Sales and Service Branches in Principal Cities • Also manufactured in Europe to U.S. Standards.



NOW... "SPECS" AT YOUR FINGERTIPS

Here's a surer, easier way to specify spray nozzles



How can you be sure you're specifying the *right* spray nozzle for your particular application?

Spraco's research department has taken the guesswork out of this problem by preparing complete and accurate performance data for each of the hundreds of spray nozzles in the Spraco line. Each nozzle "profile" is complete with data on material, dimensions, flow rate, pressure, angle of spray . . . everything you need to enable you to choose, at a glance, the nozzle that will deliver maximum performance and efficiency in your particular application.

No matter what your spray nozzle problem, Spraco makes this information available to you absolutely free. Why not write and ask about it — today?

SPRAY ENGINEERING COMPANY
115 Cambridge Street, Burlington, Mass.

SPRACO



Gauges.....The new "Master Test" series in sizes 4½", 6", 8". All standard pressure ranges 0-15 psi to 0-30,000 psi, vacuum & compound. New 20-page bulletin.
B197 *Marsh Instrument Co.

Instrument.....New miniature infrared photoelectric scanner (proximity sensor) contains both light source & pick-up head in one small housing. No. 1606.
93-94k *U. S. Industrial Chemicals Co.

Instrumentation ..... Consotrol includes control functions for all types of processing requirements—auto-selector . . . cascade & ratio systems. Bul. 13-18.
24-25 *The Foxboro Co.

Meter, pH.....New portable pH meter gives consistently accurate readings with only one weekly standardization. Features drift-free indicator needle. Tech. bulletin.
194A Sel-Rex Corp.

Meters.....measure over 150 liquids . . . water, oils, syrups, brines, soaps, chemicals, etc. Helpful Meter Data Bulletin 68XX contains all the facts.
188 *Neptune Meter Co.

Pneumatic Instruments.....The new Null-Balance-Vector line of pneumatic instruments are compact, lightweight and rugged. Additional information available.
171 *Republic Flow Meters Co.

Pneumatic Instruments.....Pressure and temperature pilots and pneumatic transmitters featured in catalog that lists specifications and describes control actions.
194B U. S. Gauge Div.

Solu Bridge.....New portable conductivity & temperature Solu Bridge for measuring tidal movements, salinity, industrial pollution, etc., is now on market. No. 1603.
93-94h *U. S. Industrial Chemicals Co.

Timing Modules.....Circuit diagrams, selection guides, standard specifications, case sizes, and wiring and application data are all included in a 16-page booklet.
194C Tempo Instrument, Inc.

Transmitters.....Data on pressure and liquid level transmitters, including the Model P, which is capable of measuring up to 250 psi is given in a 2-page color folder.
194D Conoflow Corporation

Variable Speed Drives.....A folder describes the features of a twin-strand, single roll chain for changing the ratio as the smooth facing wheels are altered.
194E Link-Belt Co.

Worm Gear Drives.....Rating tables, together with an explanation of proper selection procedures are included with descriptions and illustrations of enclosed gear drives.
194F Foote Bros. Gear and Mach. Corp.

Pipe, Fittings, Valves

Fittings.....Catalog 3108 covers the many features and uses of Hi-Seal butt-joint tube fittings in tubing circuits. Hi-Seal conforms to J.I.C. and A.S.M.E. standards.
T209 *The Imperial Brass Mfg. Co.

* From Advertisement, this issue

LITERATURE . . .

Fittings & Flanges.....Welding fittings & flanges are available in carbon steel & the B&W Croloys in a complete range of types & sizes. Bulletin FB502 offered.
100 *The Babcock & Wilcox Co.

Gages and Valves.....Catalog covers standard and special function gages and valves. Includes dimensional drawings, construction features, graphs and ratings.
195A Jerguson Gage & Valve Co.

Tubing Instrumentation ..... Copper tubing in coils up to 2200 feet for ¼" O.D.—up to 1400 feet for ⅜" O.D.—up to 1000 feet for ½" O.D. Information.
39 The American Brass Co.

Tubing Pressure.....Electricweld carbon steel tubing is available for heat exchangers, condensers, boilers, evaporators & other applications. Details.
61 *Jones & Laughlin Steel Corp.

Pipe.....Pipe sizes versus schedule numbers, with pipe weights also given, are on one side of this pipe chart and the capacities of round tanks are on the other side.
195B Peter A. Frasse and Co.

Pipe.....Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi. from below zero to 200 F. Information.
36 *Saran Lined Pipe Co.

Pipe, Plastic.....Ace-Ite, chemical-resistant rubber-resin blend pipe is the surest way to stem the tide of corrosion. Handles most chemicals. Bulletin CE-80.
162 *American Hard Rubber Co.

Pipe, PVC.....available in sizes from ½ inch to 12 inches in diameter & schedules A, 40, 80, 80, & 120. Easy to fabricate & join, has excellent impact resistance. Bul. 24.
175 *U. S. Steel, National Tube Div.

Pipe, PVC.....Koroseal PVC pipe is ideal for use wherever chemical resistance, high working pressures & good impact resistance are factors. Booklet offered.
1 *B. F. Goodrich Indust. Prod. Co.

Piping.....A new 24-page bulletin contains complete information about piping assemblies and other mechanical equipment as well as instruments control valves.
161 *Midwest Piping Co., Inc.

Piping Graphite.....Two different systems of impervious graphite piping covered in bulletin that provides detailed dimensions and photographs of all fittings and pipe.
195C Falls Industries, Inc.

Swivel Joints.....US type are designed exclusively for the chemical industry. Can be welded into the line and can be repaired on location with simple tools. Catalog.
79 *Continental-Emsco Company

Tubing.....Flo-Rol precision tubular products can be furnished from ½" to 2½" O.D. & in some instances, in lengths up to 75'. New bulletin contains information.
95 *Damascus Tube Co.

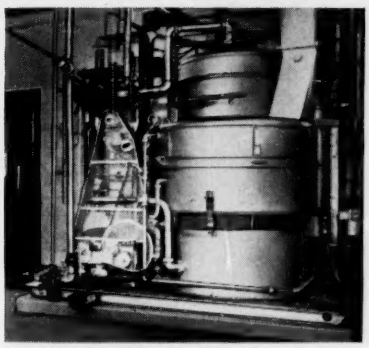
Tubing, Stainless.....Types 304 and 316 are available in all popular sizes & gauges. Up-to-date Selecting and Buying Guide Bulletin T.D. 120.
173 *The Carpenter Steel Co.

*From advertisement, this issue

3 BOILERS IN 1 COMPACT PACKAGE!



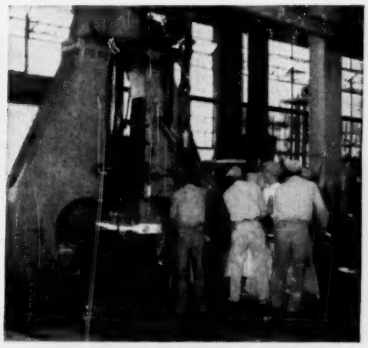
FOR ORDINARY STEAM REQUIREMENTS: The cycle-type Modulātic standard unit furnishes 90% dry steam for most ordinary needs such as cooking, heating water, drying, cleaning, etc.



WHERE DRY STEAM IS REQUIRED: The Modulātic may be used with an optional steam separator, for over 99% dry steam for heating, moulding, forges, operation of power equipment, etc.

VAPOR MODULĀTIC WATER TUBE BOILERS

¼ the size and weight of conventional boilers... largest size (150 BHP) uses only 5' x 8' space.



IF CONSTANT STEAM LOAD MUST BE MAINTAINED: For applications where even a nominal drop in pressure cannot be allowed, an optional steam reservoir may be added to the standard unit to provide a "cushion" during an off cycle.

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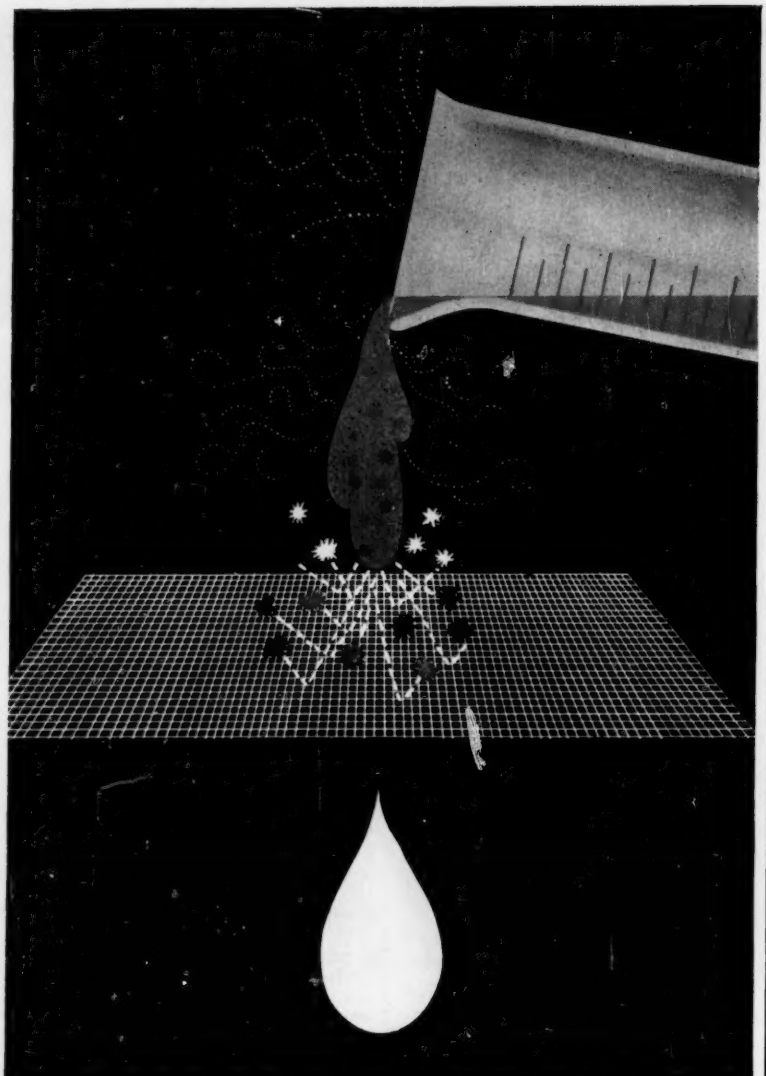
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LITERATURE . . .

Valve.....for blending, milling, conveying applications . . . wherever powders or granulations require low control. Product Data Sheet 18V is offered.
B209 *Patterson Kelley

Valve, Ball.....Flo Ball valves are available for off-the-shelf delivery to standard ASA dimensions in semi-steel, carbon steel, stainless steel & aluminum. Information.
4 *Hydromatics, Inc.

Valve, Gate.....Fig. 2453SG large stainless steel O.S. & Y. for 150 W. P. Fully guided solid wedge disc. Also available with interchangeable split wedge disc.
77a *The Wm. Powell Co.

Valve, Plug Gate.....Aloyco stainless steel #66: 1200 lb. at 150 F.; 600 lb. at 500 F. Sizes available ⅛", ¼", ⅜", ½". Additional information offered.
L198 *Alloy Steel Products Co.

Valve, Swing Check.....Fig. 2433SS large stainless steel for 150 W.P. Bolted flanged cap. Integral seat. Teflon disc & renewable seat ring available on special order. Lit.
77b *The Wm. Powell Co.

Valve, Tank.....Fig 2309 large flush bottom tank valve for 150 W.P. Designed for fast draining. Disc opens into tank. Also available with disc opening into valve.
77c *The Wm. Powell Co.

Valve, "Y".....Fig. 2107 small stainless steel for 150 W.P. Flanged ends, but can be supplied with screwed or socket welding ends. Literature available.
77d *The Wm. Powell Co.

Valves.....Ram type drain valves are designed so that in the closed position the piston or ram extends up into the tank. In open position, full flow is assured. Catalog.
152 *Strahman Valves, Inc.

Valves.....The "3 in 1" valve design combines variable orifice with shut-off & micrometer dial & pointer. Flocontrol valves are available in Bronze & Steel. Details.
42 *Manning, Maxwell & Moore, Inc.

Valves, Aluminum Gate.....for handling corrosive chemicals such as hydrogen peroxide, ammonium nitrate, acetic acid, concentrated nitric acid. Sizes from ½" to 24".
191 *Darling Valve & Mfg. Co.

Valve Check.....Bulletin describes cushioned check valves with unique design to prevent hammer damage and shock due to back surge. Schematic diagrams included.
196A Golden Anderson Valve Co.

Valves, Control.....The many special advantages of control valves are described in an informative new booklet, "What's in it for you?". Copies available.
28-29 *Minneapolis-Honeywell

Valves, Lubricated Plug.....feature instant response because piston-like movement of plug during each lubrication prevents sticking. Catalog 39-1 & prices.
137 *Homestead Valve Mfg. Co.

Valves, Safety-Relief.....A 28-page color booklet gives first listing of the new compact line along with usual cataloguing of liquid relief and special service valves.
196B Farris Engineering Corp.

*From advertisement, this issue

LITERATURE . . .

Valves, Safety Relief.....have a special "O" Ring Seat Seal that stops leakage completely. Available in both Standard & Balanced Bellows design. Bul. 1940 & Cat. 1900.
187 *Manning, Maxwell & Moore, Inc.

Process Equipment

Attrition Mill.....This most recent and complete bulletin (16 pages) covers the complete line of attrition mills, including the "Frigidisc" and the "Attritor".
197A Robinson Div. Young Mach. Co.

Blendors, Rotary.....available in nine standard models with capacities to 900 cu. ft. Feature self-cleaning, dust-sealed drum. Information on Blenders in Bul. 080B.
R198 *Sturtevant Mill Co.

Centrifugal Compressor.....New inter-cooled CVM centrifugal compressor is designed to provide high efficiency & low operating cost for 100-125 psi air. Information.
135 *Ingersoll-Rand

Centrifugal Separation.....The P-4000 Vertical Super D-Canter offers many operating advantages. New technical bulletin contains additional information. Bull. 1287.
54 *The Sharples Corp.

Centrifugals.....The HS 40 W Universal Pressure Centrifugal is engineered for normal operation at 1000 times gravity & internal pressures to 160 psi.
133 *Baker Perkins

Centrifuges.....The patented bearing located at the center of gravity & other design features permit the Reinevelds to operate at higher G-forces.
127 *Heyl & Patterson, Inc.

Chemical Fume Scrubbers.....of fiber - glass - reinforced polyester resin now being design. Units up to 47 feet high by 10 feet in diameter have been made. No. 1608.
93-94w *U. S. Industrial Chemicals Co.

Dryer.....The new Budget Air Dryer supplies up to 20 cubic feet per minute of air, dried to a dewpoint of 60 F. or lower. Complete information in Bul. B6A.
192 *Pittsburgh Lectrodryer

Dryer.....The all-new SCL dryer offers neat lower housing, complete accessibility of all internal parts & many other features. Copy of Bulletin No. 462 available.
101 *Proctor & Schwartz, Inc.

Dryers.....A new bulletin #HA-308 listing all tech. specifications & capacities of the Heat-Les dynamic desiccant dryers is now available. Includes complete formulae, etc.
197B Trinity Equipment Corp.

Dust Separators.....The basic principles of cyclonic separation are employed with the special "skimming" principle to produce 2-stage separation described in booklet.
197C The Day Co.

Evaporators.....Bulletin E-100 contains complete information on evaporators. Other equipment for the food, chemical, & petroleum industries available.
149 *Swenson Evaporator Co.

*From advertisement, this issue



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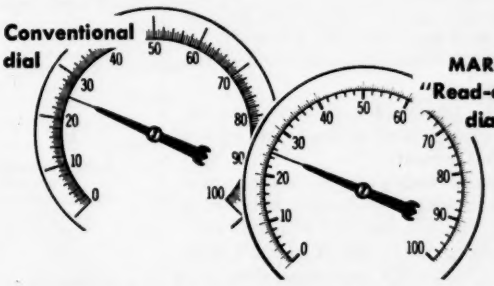
Twin-tip pointer enables observer to read "dead-on" by lining up twin tips like gun sight.



Mirror dial also insures accurate "dead-on" reading.



"Non-parallax" dial has Plexiglas insert that assures accurate reading even when read at angle.



New "Read-easy" dial (patent pending), as illustrated above, assures reading accuracy in keeping with indicating accuracy. Also note three advanced means of reading available in all "Master-test" gauges: twin-tip pointer, mirror dial, and "non-parallax" dial as shown opposite.

Sizes 4½", 6", 8". All standard pressure ranges 0-15 psi to 0-30,000 psi, vacuum and compound.

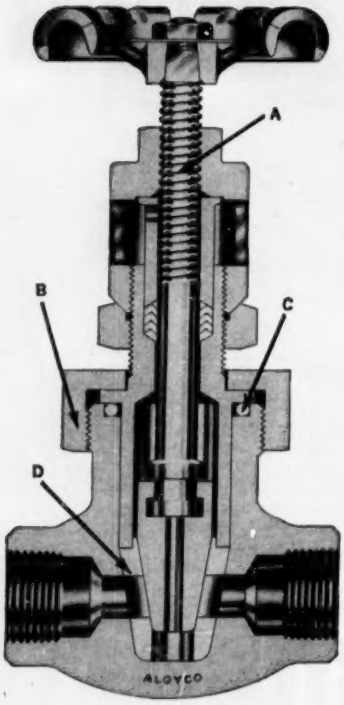
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Division of Colorado Oil and Gas Corporation

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Aloyco Plug Gate Valve #66 succeeds with severe corrosives for 10 straight years!



Shown ⅔ actual size of the half-inch valve

WHY? **A. OUTSIDE STEM THREADS** are away from corrosive area, prevent galling.
B. UNION BONNET provides extra strength and easy disassembly.
C. O-RING made of "Teflon"* provides tough, leak-proof seal.
D. SEATS made of "Teflon"* are pressure-tight, dependable, won't gall. Renewable.
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FOR: Instrument lines, small lines handling viscous fluids, or where low pressure drop is important.

FACTS: full-floating plug disc exerts no twisting action on the removable seat in closing. Aloyco Stainless Steel #66 Plug Gate Valve: 1200 lb. at 150 F.; 600 lb. at 500 F. Sizes: ⅛", ¼", ⅜", ½". Want more? Write: Alloy Steel Products Company, 1301 West Elizabeth Ave., Linden, New Jersey. C-5

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Longer Lasting ALOYCO VALVES — Try in Corrosive Service

ALLOY STEEL PRODUCTS COMPANY

LITERATURE . . .

Filter.....The EimcoBelt filter's new operating principle now makes it possible to filter a whole category of difficult slurries. Information in Bulletin F-2053.
Cover *The Eimco Corporation

Filters.....Durco-Enzinger dry cake discharge filters are designed for simple, fast recovery of even the heaviest cakes. Listing of filtration equipment in Bul. EF/2a.
141 *The Duriron Co., Inc.

Gas duffuser.....Bulletin covers operation, applications, differences compared to other diffusers, design criteria and model availability for evaluation.
198A Yeomans Bros. Co.

Homogenizers.....Complete information and bulletins on the Laboratory Homogenizer L3-55, Sub-Micron Disperser SMD-55, and Homogenizers H-55, is available.
170 *Manton Gaulin Mfg. Co.

Mills, Roller.....are engineered for automatic, uniform fine grinding. Feature whizzer air separation, Pneumatic feed control and are self-lubricating. Catalog No. 79.
102 *Combustion Engr., Raymond Div.

Mist Eliminators.....Optimum usage of mist eliminators is illustrated by graphs, and equipment is shown in flow drawings in this bound 5-page color booklet.
198B Metal Textile Corp.

Pelletizing Machinery..... Unique, new simplified design. Special stationary die, horizontal head. Alloy construction as desired. Additional information in Bul. L-109.
T158 *Daffin Mfg. Co.

Reversible Impactor.....features reversible rotation, wide open accessibility and interchangeable impact blocks. Sizes & models for your exact needs. Catalog.
45 *Williams Patent Crusher

Screw Conveyors.....Boasting ratings from ½ to 30 horsepower and an output torque to 21,400 lb.-in., new screw conveyor drives are described in Bulletin 7106.
198C The Falk Corporation

Scrubber, Wet Bed.....The "Cyclonaire" is available in four sizes with rated capacities of 750, 1650, 3500 & 6000 cfm. Full technical data in Bul. FW-10.
52 *U. S. Stoneware

Separators.....in service for any problem involving liquid-vapor separators or wet and dry type dust scrubbers & gas filters. Details available.
157 *Peerless Mfg. Co.

Spray Nozzles.....Information is now available for each of the hundreds of spray nozzles. Data on material dimensions, flow rate, pressure angle of spray, etc.
194 *Spray Engineering Co.

Strainers.....Information on all types of strainers including pipeline strainers, scraper strainers both hand operated & motorized, and self-cleaning Y-type.
156 *Sarco Co., Inc.

Vibratory Equipment.....A 68-page condensed catalog is presented giving materials handling equipment plus the Syntron line of car rappers, feeders, conveyors, etc.
198D Syntron Company

*From advertisement, this issue

Highly Intimate Blends in 1 to 2 Minutes

Blends while discharging; No segregation or flotation

Sturtevant Rotary Blenders start 4-way blending while charging, continue it during discharge, thus producing highly intimate, even blends of dry and semi-dry materials – within 3 to 5 minutes of start of charging.

Six *complete* blending cycles per hour are common. And Sturtevant's special action produces no particle reduction, cleavage or attritional heat – is highly effective yet gentle and safe even with explosives.



Receiving
Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.



Discharging
Single gate controls charge, discharge. Blending continues throughout discharge phase. Result is no segregation or flotation — highly intimate, even blends.

Self-cleaning, dust-sealed drum; one-man accessibility

Operation of Sturtevant Blenders is self-cleaning – drum interiors are completely dust-sealed. For inspection of all models, one man simply loosens a few lugs to remove manhole cover – quickly and easily.

Nine standard models with capacities to 900 cu. ft.



10 cu. ft. Sturtevant Blender at U.S. Steel Corp.'s new Applied Research Laboratory (Raw Materials Division) in Monroeville, Pa. This unit handles batches up to 500 lbs. — is ideal for pilot work and small runs.



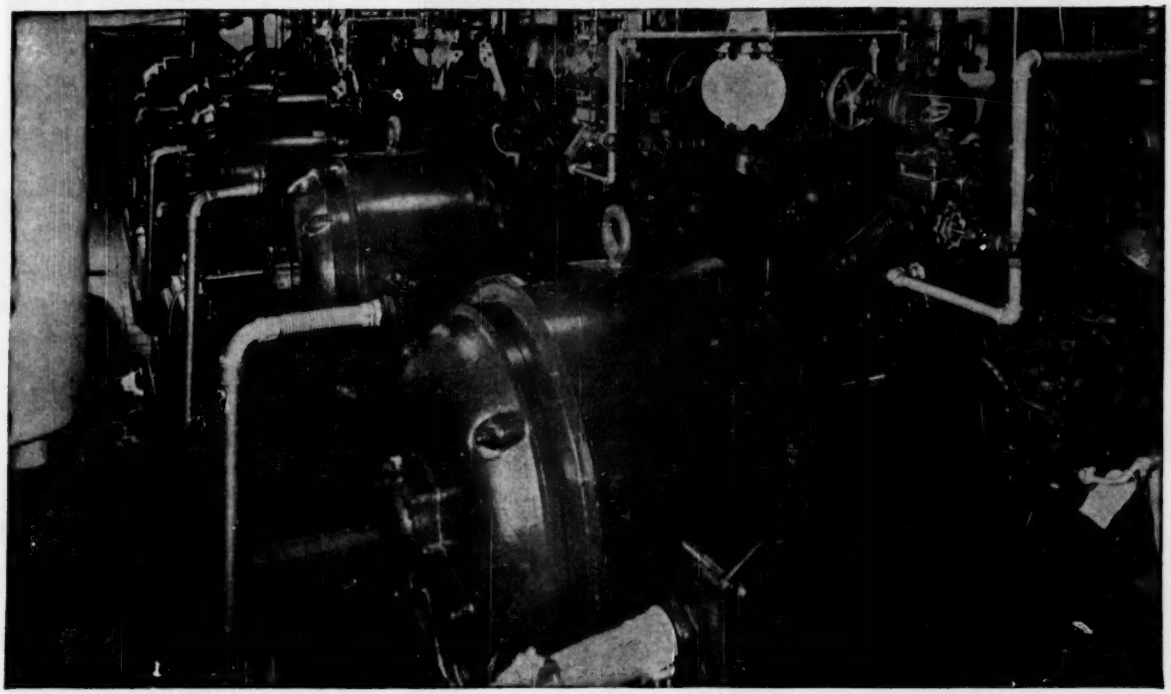
One of four 450 cu. ft. Sturtevant Blenders at Celriver Plant of Celanese Corp. (Rock Hill, N. C.). These large units handle up to 20,000 lbs batches — have a 9-year record of meeting the most exacting blending requirements.

Fully or semi-automatic, or manually controlled operation

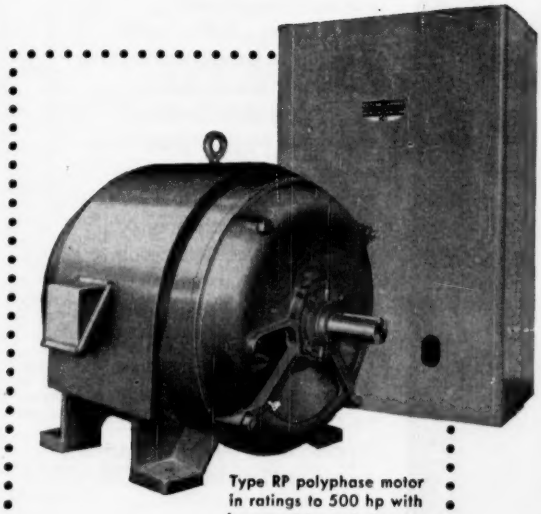
Constructed of carbon steel, stainless steel or Monel metal, Sturtevant Rotary Blenders are engineered to fit each customer's needs – can be supplied with injector sprays and any desired control system.

For more on Sturtevant Blenders, request Bulletin No. 080B. (Bulletins also available on Mixers, Air Separators, Micronizers, Crushers and Grinders.) Write today. STURTEVANT MILL CO., 100 Clayton St., Boston, Mass.

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Line disturbances are reduced because current taken from the line is not broken during the starting period. Motors start sure and fast . . . reach full speed in a matter of seconds. And . . . Wagner combinations cost less than motors with primary resistance or auto-transformer type starters.

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While 2-step combinations are suitable for most applications . . . 3, 4, 5, or 6-step increment motor-starter combinations are available for installations where unusually low inrush of starting current is required. All meet the polyphase motor-starting requirements of AEIC-EEI-NEMA.

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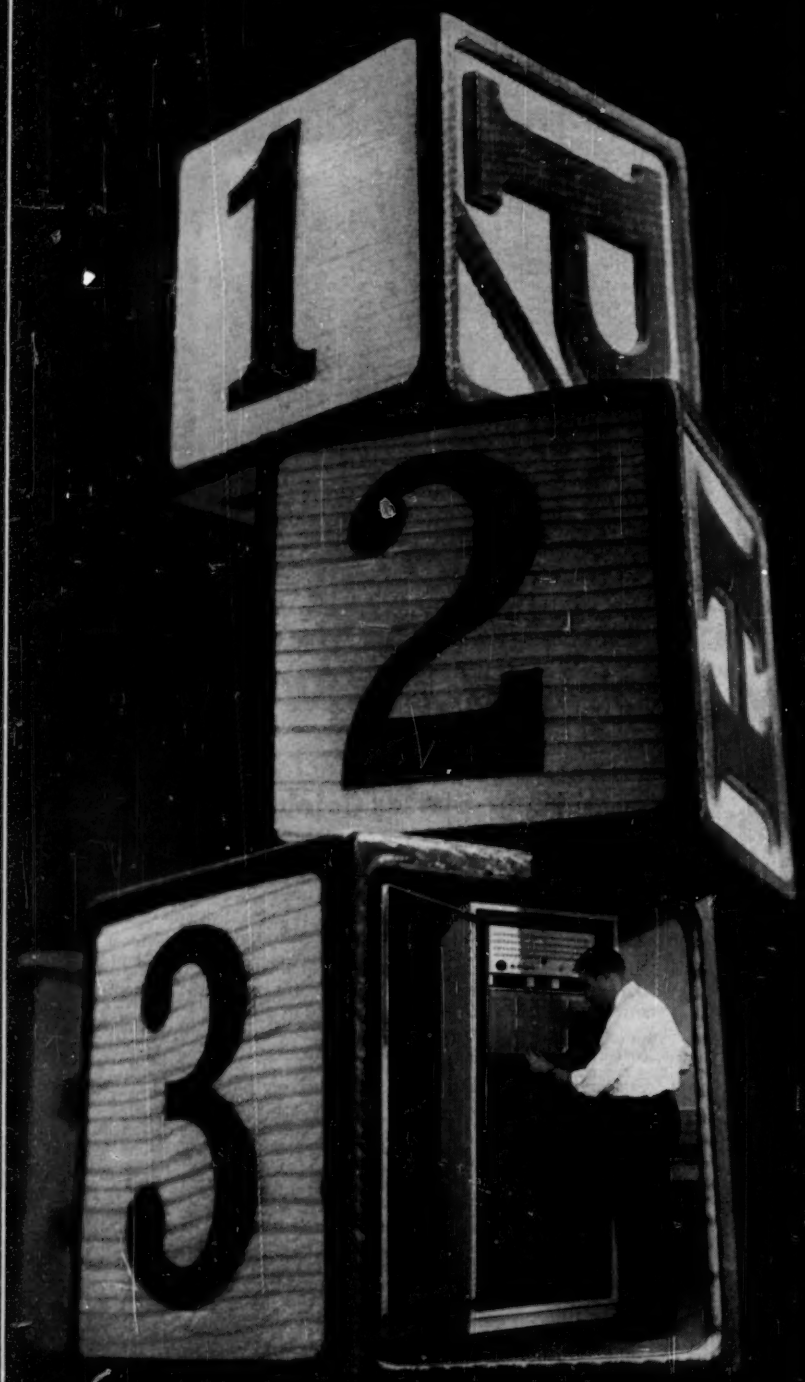
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201A Leiman Bros. Inc.

Centrifugal Compressor.....Design and construction features described in bulletin that discusses compressors available in capacities from 1000 cfm to 150,000 cfm.
201B Allis-Chalmers Mfg. Co.

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201C American Air Filter Co.

Fan.....Type FG features flanged inlet & outlet. Capacities up to 34,000 cfm. & pressures up to 10" static. Bul. FI-511 for details & chemical resistance table.
33 *Buffalo Forge Co.

Pump, Metering.....Four standard sizes up to 54 GPH, pressures to 300 psi. Duplex units provide twice the capacity with one motor. Complete information.
201 *The Madden Corp.

Pump, Vacuum.....Complete information about the new Series H Microvac pump is available. Also a free vacuum slide calculator is offered to you.
186 *F. J. Stokes Corp.

Pumps.....The Model F(B) pumps are available in capacities to 4200 gpm and heads to 500 feet. Handle corrosive liquids at up to 550 F. Information on request.
71 *Allis-Chalmers

Pumps.....Bulletin 1040-4 gives design features and operating curves on seales pumps for leakproof pumping of high temperature fluids up to 1000F.
201D Chempump Div.

Pumps.....Types Q and SQ can handle considerable volumes of air or gas mixed with liquid. Facts about these pumps & the advantages of the open impeller design.
38 *The Labour Co.

Pumps.....**Bulletin describes line of** internal and external bearing type pumps to handle lubricating and non-lubricating materials in viscosities to 5,000,000 SSU.
201E Sier-Bath Gear & Pump Co.

Pumps.....Revised Bul. 230 describes horizontal duplex steam pumps for boiler feed, fuel oil pressure, oil transfer, general water service, & a variety of other services.
201F Warren Pump Co.

Pumps, Glassed.....in conventional hydraulic design, simplifying installation & maintenance. Four sizes with capacities up to 700 GPM, heads up to 140'. Bul. 725.2.
40 *Goulds Pumps Inc.

Pumps, Plastic.....“Alpha Series” for handling hot concentrated acids, alkalies, salts & many solvents. Operating data, chemical resistances, and prices on request.
160 *Chemtrol

Pumps, Proportioning.....Feed precisely metered fluids or slurries in all ratios with controlled process variables. Bulletin covers 100 series and 200 series.
174 *American Meter Co.

Pumps, Vapour Booster.....Three important features, high speed, high critical backing pressure & low heater input are found in all Speedivac pumps. Information.
B158 *Edwards High Vacuum Inc.

Vacuum Pumps.....Brochure describes line of oil-sealed rotary vacuum pumps with interchangeable pistons. Operational data and physical specifications also given.
201G Consolidated Vacuum Corp.

Pumps, Waste Handling.....A guide correlating waste and liquid characteristics with pump capacities, heads, and designs is the heart of this new 4-page folder.
201H Yoemans Bros. Co.

Turbine-Compressor.....There are 48 compressor frame sizes, providing excellent choice for all applications over the entire range of capacities from 500 to 600,000 cfm.
153 *Elliott Co.

Services & Miscellaneous

Corrosion-Proofing Service.....Typical successful installations include flooring, tank linings, foundations, pits, piers, waste disposal systems, etc. Information.
190 *The Ceilcote Co., Inc.

Exchanger Cleaning.....Detailed literature on this cleaning process and other chemical plant maintenance operations is available now on request.
168 *Oakite Products, Inc.

Pliers.....in over 60 models and sizes. Feature engineered handle design for correct leverage. Catalog listing the complete series, plus full range of wrenches & hand tools.
180 *Snap-On Tools Corp.

Portable Water Softener.....recently developed works by electric membrane process, is claimed 500 times more efficient than comparable electrical devices. No. 1604.
93-94i *U. S. Industrial Chemicals Co.

Process.....Patented process, called Polyfusion, has been reported for joining polyethylene pipe & fittings, using nothing but heat & a special tool of simple design.
93-94c *U. S. Industrial Chemicals Co.

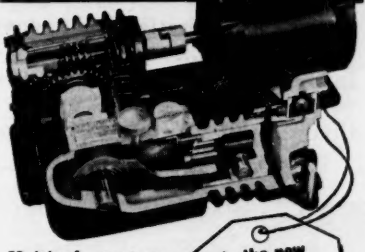
Story of Chemistry.....is the subject of a new book now being sold. It is divided into Part I and Part II. Information about this is available. No. 1609.
93-94r *U. S. Industrial Chemicals Co.

Two-Way Radios.....Tubed and transistorized models and their differences are explained and demonstrated in this new radio catalog.
201I General Electric Communication Products.

Welding Aid.....Chart designed as aid for engineers and designers specifies correct filler alloys for all recommended wrought alloy parent metal combinations.
201J Aluminum Co. of America

*From advertisement, this issue

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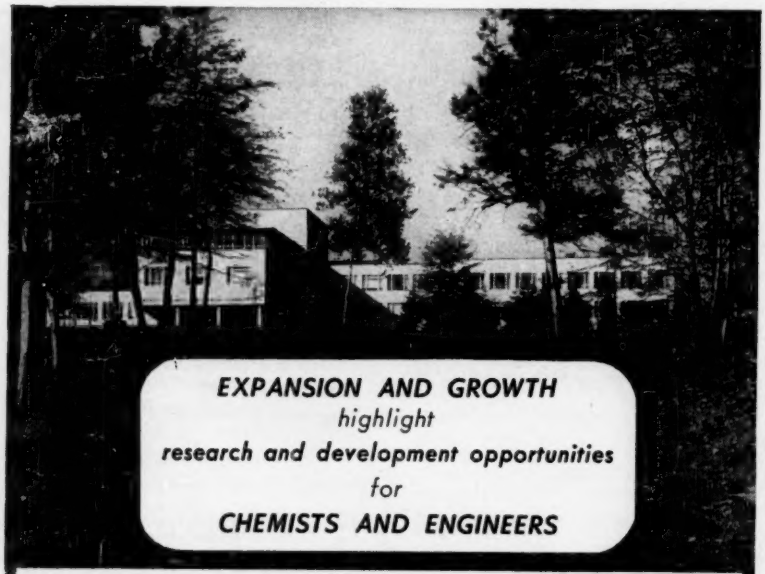
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There is an opportunity in our New York office for a young chemical engineer who thinks his real field is in selling. We are one of America's oldest and most firmly established manufacturers of corrosion-resistant materials and equipment. Our products cover a wide segment of industry and are accepted as top quality everywhere. The man we want should be in his late twenties or early thirties. We would be happy if he has had selling experience to industrial accounts. He must have the ability to meet and discuss products with technical and purchasing personnel. It's an attractive job right now—will be more attractive as the years go by.

Please tell us all about yourself in a letter.

THE U. S. STONEWARE CO.
60 East 42nd St. New York 17, N. Y.

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POSITION VACANT

Chemical Engineer—With experience in production of inorganic chemicals required for South American position. Spanish required. P-4182, Chemical Engineering.

Chemical Engineer wanted for progressive equipment designing and manufacturing company in western Pennsylvania. Will consider recent graduate or man with experience. Please submit record of education, experience, and references. P-4521, Chemical Engineering.

Need Engineers?

Contact them through this
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DIESEL LOCOMOTIVES & CRANES

7—115 ton 100 ton 45 ton 60 ton GE.
3—New 25 Ton, 2 GE 1 Whitcomb.
1—44 Ton, 1-80 Ton Used Gen. Elec.
1—25 Ton, Industrial 60' Boom Loco. Crane.

PLANT EQUIPMENT

4' Telsmith TY Gyratory Crusher.
2—Wemco 2M-HMS-Plants.
No. 5060 Dixie Mogul Hammermill 500 H. P.
2—6' x 36' Hardinge Ball Mills.
2—5' x 8' Kennedy Van-Saun air swept Ball Tube Mills with Motors & Elec. Eye.
7' x 24' Allis-Chalmers Tube Mill.
5' x 10' & 7' x 15' Rod Mills.
14" x 28" & 30" x 36" Traylor Type H Jaw Crushers.
48" x 72" Buchanan Type "C" Jaw Crusher.
56" x 72" Traylor Style G Jaw Crusher.
No. 1 Sturtevant Rotary Fine Reduction.
2' Symons Standard Cone Crusher.
322 AC Type R Hydracone Crusher...
207-10 Type 316 SS LB Roto Louver Dryer.
36" x 20' Ruggles Coles Class XF-1 Rotary Dryer.
36" x 30' Hardinge Brick Lined Rotary Kiln.
#207-10 & #705—24 Link Belt Roto Louver Dryers.
Link-Belt Mono-Tube 24-10 Dryers.
54" x 35' Louisville Monel Steam Tube Dryer.
72" x 28' Madison Rotary Dryer.
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42" x 18" Traylor Type AA Crushing Rolls.
5'-6" x 60' Rotary Dryer or Cooler.
F55 Syntron Grizley Feeder.
24" x 95' NEW Hewitt Robins Truss Belt Conveyor.

R. C. STANHOPE, INC.
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CIRCLE B ON READER SERVICE CARD

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Autoclave: 50 gal. Struthers Wells, st. st.
Centrifugal: Tolhurst 20" st. steel (New).
Centrifugal: AT&M 60" st. st. perf.
Concentrating Table: Deister #14, 5' x 8'.
Dewaterers: Davenport 3A, bronze hd. 3 hp.
Disintegrator: Rietz RD18P, 75 hp.
Dryers: Devine 2 x 4' vac. drum, st. steel.
Dryer: Bowen lab. spray st. steel.
Dryer: American atmospheric 24 x 48"
Evaporator: Buflovak st. st. 94 sq. ft.
Filter: Oliver precoat 12x2" st. steel.
Homogenizers-Dispenser: Tri-Homo #10, #4
Kettles: st. steel, with and without ag. Dopp 150 gal. dbl. act. agitator.
Mills: Mikro, ISH, 5 hp. Day 3-roll high speed 14x30"
Mikro Atomizer type 5MA st. steel. Colloid, 3, 5, 20, 25 hp.
Mixers: Dbl. and sgl. arms sigma blade. Dry Powder, various sizes.
Mix-Muller: Simpson Porto 39" st. steel.
Pumps: Rotary, gear, centrif. vacuum.
Screen: Rotex model 41 st. steel.
Still: Double effect st. st. 11.83 gal.
Tablet Press: Stokes DD2, 23 station.
Truck Tanks: Stain. steel 1200, 1600 gal.
Vacuum Pans: 42" and 72" stain. steel.

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820 WEST SUPERIOR ST. CHICAGO 22 ILLINOIS

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VALUES GALORE—*BUY NOW*

Patterson Jack. Ball Mill 5' x 6'—25 HP.
Day #31 Robali Sifter, all S.S. 20" x 48".
Spiral Mixers 1000# to 3000# Capacity.
Raymond 36" Whizzer Air Separator.
Rotocione Size 16, Type W.
Sturtevant 2 x 6 Open Dr. Lab. Crusher 5 HP.
Jeffrey Traylor S.S. Double Deck Vib. Screen 30" x 60".
Shriver 30" C.I.F.P. 30 Ch. 1" cake.
Raymond #3036—High Side Mill.
Tanks S.S. 100 to 600 Gals. Cap.
Autoclave S.S. 30 Gals. 1000 psi., w/Pulsafeeder.
Cyclotherm Boiler 620# hr. @ 250 psi.
Conveyors, Labelers, Agitators, etc.

We buy your surplus. Send us your inquiries.

THE MACHINERY & EQUIPMENT CO.
Used Div., HARING EQUIPMENT CORP.
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Market 2-3103

CIRCLE A ON READER SERVICE CARD

OUTSTANDING VALUES!

Mikros 4-TH, 3-TH, 2-TH, 1-SI.
Lee 300 gallon jacketed kettles, SS.
Day 125 gallon gearless pony mixers.
Pfaudler 500 gallon series R glass lined reactor.

CHEMICAL & PROCESS MACHINERY CORP.
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CIRCLE G ON READER SERVICE CARD

CLASSIFIED . . .

EQUIPMENT SEARCHLIGHT

CE's Searchlight spots the big bargains in used, resale and rental equipment. Check this issue's listings—most complete in the field—for items you need now

▶ **Coverage** — National Equipment and facilities—used, resale and rental—for the process industries. For sale, wanted, for rent.

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6—New Syntron Vib. Spiral Elevators. Stainless 8'6" lift. Complete

1—Louisville 54" x 35' Monel Rotary Steam Tube Dryer. 1150 sq ft

1—66" x 33" Rotary Flame Dryer. Nickel lined monel lifters. Welded

3—A T & M 40" Steel perf. basket Centrifuges. 15 HP 2 speed motors

2—Tolhurst 48" S.S. Perforated bas. Centrifuges. W/Mtr.

1—Oliver 3' dia. Horiz. Filter, type 316 Stainless Steel

2—Raymond #1 auto. Pulverizers. With 5'6" Whizzer Separator

1—Raymond 4 Roller Hi-Side Mill. Dbl Cone Separator.

For immediate quote, wire or phone collect—GA 1-1380

ME MACHINERY AND EQUIPMENT COMPANY
123 Townsend St. - San Francisco 7, California

CIRCLE E ON READER SERVICE CARD

AGITATOR—S/S w/10 HP xpl. proof 2 spd motor, 3" shaft x 6' long w/propeller—1 HP Lightnin' 1150 RPM

SCREENS—12" x 72" S/S Ajax—20 x 84, 20 x 96 Rotex—3 x 5, 3 x 10 Tyler Hummer

FEEDERS—S/S Vibrating 4½ x 24, 24 x 72 Syntron—Hardinge B Constant Weight

MILLS PULVERIZING—3 HP Sturtevant 00—10 HP Mikro 2 TH—30 HP Raymond—50 HP Mikro 3 TH w/Mikro Collector (unused)—100 HP Jeffrey 36 x 42—250 HP non-clog—450 HP Penna. SXT 14.

DRYERS, ROTARY—24" x 22', 3' x 24', 4' x 40', 5' x 50', 6' x 30', 7' x 58' all w/motor drives

DRYER, VACUUM SHELF—w/13 shelves 59" x 78", total area 356 sq. ft.

BRIQUETTING MACHINE—Komarek Greaves, 11/16 x 4-5/16 x ¼" dies w/feeder, motors, etc.

LAWLER COMPANY
Durham Ave. Liberty 9-0245 Metuchen, N. J.

CIRCLE F ON READER SERVICE CARD

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2,000,000 ft. 2"	3.50#	to the foot
1,000,000 ft. 3"	7.70#	
1,000,000 ft. 4"	10.98#	
500,000 ft. 6"	19.80#	
200,000 ft. 8⅝"	28#	
400,000 ft. 10¾"	35#	
75,000 ft. 12¾"	40#	

All No. 1 Grade Plain End and Cleaned
INDIANA-OHIO PIPE CO.
P.O. Box 5412 Shepard Sta. Phone CL 3-5527
COLUMBUS 19, OHIO

CIRCLE J ON READER SERVICE CARD

CHEMICAL EQUIPMENT DIVISION

Raymond 3 Roll #3036 Hi-Side Mill
Buflovak 19 Shelf Vacuum Shelf Dryers
1000 sq. ft. Stainless Heat Exchangers (2)
Tolhurst 40" S.S. Center Slung Centrif.
Fletcher 40" Susp. Steel Centrifugal
Sweetland #12, #10, #7 Filter Presses
30 Gal. S.S. Jktd. Autoclave 1000 PSI Int.
Shriver 30"x30" P&F 36 C.I. Chambers
Nooter 750 gal. Steel Reactor 300 PSI
Traylor 8' x 11' Ball Mill
Allis-Chal. 8'x60'x1½" Welded Rotary Kilns
Vulcan 6'x120'x1½" Rotary Kiln
Link Belt 502-16 Roto-Louvre Dryer
8' x 80' Rotary Dryer 316 S.S.
Mosser 4' x 47' Rotary Dryers
Louisville 6'x50'; 6'x25' Steam Tube Dryer
Stainless Tanks 100, 200, 350 gal.
Condensers 100 to 5000 sq. ft. Steel; Admir.
Pressure Vessels 300 to 4500 gal.
Dixie #5060 Mogul Hammermill
Raymond #50, #40 Impact Mills

HEAT & POWER CO. INC.
60 E. 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa 3, Okla.

CIRCLE H ON READER SERVICE CARD

BUY BRILL

CENTRIFUGES

2—Sharples C-27 Super-D-Hydrator, 316 S.S. Monel.
1—Bird 18"x28", Solid Bowl, Continuous, 316 S.S.
1—Bird 36"x50", Solid Bowl, Continuous, 347 S.S.
3—Sharples PY14, PN14 Super-D-Canters 316 S.S.
1—Tolhurst 26" susp. Rubber Imperforate Basket.
1—Tolhurst 32" susp. 317 S.S. Perforated Basket.
2—AT&M 48" Suspended 316 S.S. Perforated Basket.
2—Sharples #16, 304 S.S., 3 HP motor.

REACTORS—EVAPS—CONDS—TANKS

1—Alloy 75 gal. 316 S.S. Jktd., Agtd. Reactor.
1—650 gal. 304 S.S. Reactor with 100 sq. ft. Bayonet Heater.
1—1400 gal. Blaw-Knox, steel, jacketed, agitated Reactor.
1—4000 gal. 316 S.S. clad agitated Reactor with coils.
1—550 sq. ft. Buflovak monel single effect Evaporator.
1—7500 gal. 316 S.S. Vert. Storage Tank, 7'x25', 50 psi
1—750 gal. nickel clad Mixing Tank, 125# nickel coils.
6—1200 gal. 304 S.S. Tanks, 6'x6'x6".
1—4000 gal. Haveg Vert. Tank, 8'x12'.
3—7500 gal. Rubber Lined Tanks 10'x13'.
1—1500 gal. Stainless Pressure Tank, 5'x10', 90#.
1—12,000 gal. horiz. steel Pressure Tank, 7'6"x36', 200 psi.
6—Stainless Heat Exchangers; 1220, 786, 536, 370, 315, 250 sq. ft.
1—Falls Industries 100 sq. ft. Karbate Condensor.
1—24" dia. x 35', 304 S.S. Bubble Cap Column.

FILTERS

1—Oliver 6' dia. Horizontal Filter, 316 S.S.
1—Oliver 3'x6' Steel Rotary Vacuum Precoat Filter.
1—U.S. 200 sq. ft. 304 S.S. Auto-jet Filter.
1—Oliver 5'3"x8' Steel Rotary Vacuum, vaportite housing.
1—Feinc 5'x6' Stainless Steel Rotary Vacuum Filter.
2—#10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

DRYERS

1—Buflovak Vacuum Shelf with 20—60"x80" shelves.
1—Devine Vacuum Shelf with 19—59"x78" shelves.
1—Devine Vacuum Shelf with 10—40"x43" shelves.
2—Buflovak 42" x 120", atmospheric double drum Dryers, complete.
2—Devine 4'x9', single drum, atmospheric.
1—Buflovak 3'x10' Rotary Vacuum Dryer.
1—Baker Perkins 5'x6"x6' Rotary Vacuum Dryer.
1—Louisville 6'x45', 316 S.S. Rotary Steam Tube Dryer.
2—Louisville Rotary Steam Tube 6'x25', 6'x50'.
2—Louisville 8'x50' Stainless Steel lined Rotary Dryers.
9—Rotary Dryers, 34"x30', 4'x40', 6'x50', 6'x60', 7'x80', 8'x87'.
1—Traylor 30"x18' Stainless Steel Rotary Dryer.
2—Link Belt, 7'5"x25', 6'4"x24", S.S. Louvre Dryers.
2—Atmos. Tray Dryers, 16 shelves, 40"x24".
1—P&S 10' wide Apron Conveyor Dryer 48' long.

MIXERS

1—Baker Perkins 100 gal., jacketed, double arm, 30 HP.
1—Baker Perkins #16TRM, 150 gal., jktd., Vac. 60 HP.
1—Baker Perkins 50 gal. jacketed, double arm.
1—Baker Perkins 9 gal. jacketed 304 S.S. double arm.
5—Day "Cincinnatus" double arm, 250 and 100 gal.
2—Steel jacketed Powder Mixers, 225 and 350 cu. ft.
1—Patterson 6' dia. Conical Blender 15 HP.
1—500# Abbe 304 S.S. Powder Mixer.
1—3' dia. Simpson intensive Mixer.
1—Stokes 21K, 304 S.S. Granulating Mixer 82 gals.

MISCELLANEOUS

2—ISH Mikro Pulverizers, 3 HP.
3—Abbe 2½'x3' porcelain lined Pebble Mill XP motor.
2—Abbe #4 Eureka Jar Mills, 21 gals.
1—Raymond 10; dia. Single with Separator.
1—#5 Mikro Atomizer with motor and cyclone.
2—Bantam Mikro Pulverizers, S.S.
1—No. 1 Ball & Jewell Rotary Cutter.
3—Swenson Walker Continuous Crystallizers, 24" x 30' sections.
2—Robinson Sifters, 40" x 84", Stainless.
1—#24 Rotex Sifter, 20"x64", Quadruple deck.
1—#11 Ro-bal Sifter 20" x 48" 304 S.S.
8—Stokes: DD2, DDS2, T, "R", and "F" Tablet Presses.
4—Nash Vacuum Pumps: H6, TS7, #2.
25—Chlorimet, Durimet and Duriron Centrifugal Pumps, 1½" to 6".

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35-65 JABEZ STREET **NEWARK 5, N. J.**
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CIRCLE K ON READER SERVICE CARD

MODERN REBUILT MACHINERY

UNION Rebuilt Machinery Established 1913

Baker Perkins, Day, W. & P. Heavy Duty Mixers, 2½ to 150 gal. caps., Jacketed and Unjacketed.
Stokes 90-D Automatic Stainless Steel Tube Filler and Closer.
Pneumatic Scale High Speed Automatic Cartoning Line with Feeder, Bottom Sealer, Top Sealer, Wax Liner, Interconnecting conveyors.
Standard Knapp, A-B-C, Ferguson and Ceco Case Sealers.
WRAPPERS: Package Machinery, Hayssen, Battle Creek, Scandia, Wrap-King, all sizes and models.
Stokes Model DD-2 Rotary Tablet Machine. Also Models R and RB-2.
Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers.
Day 50 gal. gearless Pony Mixer.
Colton 6 ft. Diam. Stainless Steel Pan.
Stokes & Smith Model G1, G2, HG84, HG87, and HG88 Auger Powder Fillers.
Raymond "O" Pulverizer.
Mikro Pulverizers, Bantam, 1SH, 2TH, 3TH and 4TH.
Fitzpatrick Comminuters.

Complete Details and Quotations Available on Request

UNION STANDARD EQUIPMENT CO.
318-322 Lafayette St. **167 No. May St.**
New York 12, N. Y. **Chicago 7, Illinois**
CAnal 6-5333 **SEely 3-7845**

CIRCLE L ON READER SERVICE CARD

2 colloid Mills 40 HP EX. PR.
Dowtherm 225 KW
Stokes R Tablet
50 gal. S.S. Autoclave 2000 lbs. pressure
3½ gal. S.S. Autoclave 2000 lbs. pressure
Vulcanizer 60" x 9' 125 lbs.
Sweetland #2 all stainless
Stainless steel Ball Mill
Proctor & Schwartz finned drum driers

MACHINECRAFT CORPORATION
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Newark 5, N. J. **Mi 2-7634**

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COMPRESSORS

No better values at any price

74 CFM 1500 PSI 6¼-3¾-1⅜x7 CP. TCB3
100 CFM 150 PSI 6x7 Ing. ES-1
104 CFM 2500 PSI 6¾-4¼-11/16x9 IR-ES3
110 CFM 3000 PSI Ing. GC 50BW
138 CFM 100 PSI 7x7, Ing. ES, CP & Joy
151 CFM 3000 PSI 13¾x12 Norwalk TRS-4T
288 CFM 100 PSI 9x9 Ing. Worth. CP & Penn
311 CFM 1500 PSI 10½-7⅛-3½x13 IR-ES3
351 CFM 350 PSI 11-5x11 CP TCB-2
465 CFM 100 PSI 12x11-1R-ES-1-Chic. P.T.
660 CFM 125 PSI 11¼-7x7 Joy Wn 102
686 CFM 100 PSI 14x13 Ing. ES-Chic. P.T.
877 CFM 125 PSI 17-10½x14 IR. XRB
1600 CFM (actual) 100 PSI C300-300H Fuller (2)
1721 CFM 110 PSI 23-14x16 Ing. PRE2
2506 CFM 50 PSI 18-19x14 Pennsylvania DE-1
3135 CFM Vac. 31x13 Ing. ES-Worth HB

AMERICAN AIR COMPRESSOR CORP.
Chem. Road, North Bergen, N.J. UNion 5-1397

CIRCLE N ON READER SERVICE CARD

WIRE US COLLECT!

NEW WESTBILT MIXERS

In Stock

2—New 40 cu. ft. Westbilt Double Ribbon Mixers. 30" wide 8' long, center discharge. Covers, with or without Motor.

Immediate Delivery

ME MACHINERY AND EQUIPMENT CO.
123 Townsend St. - San Francisco 7, Calif.

CIRCLE O ON READER SERVICE CARD

LIQUIDATING

T316 SS CHEMICAL EQUIPMENT
ORANGE, TEXAS

1—Struthers-Wells 3500 gal. T316 SS reactor, jkt. & 40/20 HP Agit., w/int. T316 SS coil
1—Alco 110 sq. ft. T316 SS vert. pressure leaf filter.
2—Vulcan 96" dia. T316 SS bubble cap columns, 37' high
1—Vulcan 72" dia. Copper column, 4' high, VACUUM.
1—17,650 gal. T316 SS horiz. tank, dished heads, coil
3—Worthington 160 ton steam-jet Vac. refrigeration units.
2—Sharples #C-20 Super-D-Hydrators, T316 SS
2—Buffalo type #R, T316 SS blowers, 2330 cfm, 60 HP
2—American type #R T31 SS blowers, 5600 cfm, 50 HP
2—Read 1800 cu. ft. T304 SS weigh hoppers, with T304 SS elevators, shaker conveyors, etc.
1—Struthers Wells 630 sq. ft. T316 SS evaporator.

MANY, MANY OTHER ITEMS
SEND FOR ILLUSTRATED CIRCULAR #1259A

TANK–VESSELS

3—18,000 gal., vert., alum., 12' x 31', cone bottom
1—17,650 gal., horiz., T316 SS, 9' x 36', ¼" shell, ⅜" dished heads, 40# WP.
1—5800 gal., vert., alum., 10' x 10', agit.
10—4550 gal., vert., Nickel-clad, 8' x 11', 125# WP.
1—3700 gal., vert., T304 SS, 6' x 17' VACUUM, int. coils.
1—3300 gal., vert., T304 SS, 6' x 14'6", ⅜" shell, ⅜" heads, 70# WP.
3—2750 gal., vert., T316 SS, 7' x 8', dished heads, 50# WP, 75 sq. ft. coil.
4—2600 gal., vert., T316 SS, 7' x 8', flat bottom, 19# WP, 5 HP agit.
1—2500 gal., vert., T316 SS, 7' x 7', ¼" shell, 5/16" dished heads, 70# WP.
5—2250 gal., vert., T316 SS, 7' x 6'3", dished heads, 70# WP, 5 HP agit.
1—2100 gal., vert., T316 SS, 6' x 9'10" open top, cone bottom.
1—2100 gal., vert., 6' x 10', dished heads, rubber lined.
1—2100 gal., vert., alum., 6' x 10', dished heads.
1—1900 gal., vert., T316 SS, 6' x 8', ⅜" shell & dished heads, VAC. or 100#.
12—1750 gal., vert., hoppers, T304 SS, double cone bottom.
2—1200 gal., vert., T316 SS, 5' x 7', cone bottom, VACUUM.
100—Tanks & vessels, 100 to 1000 gal., all types, etc.

JUST PURCHASED

1—Baker-Perkins #15-UUMM 100 gal. Dispersion mixer, 100 HP, jacket, compression cover, screw tilt, cored blades
2—Buflovak VACUUM Shelf Dryers; 110, 98 sq. ft.
3—National Iron 10' dia. x 78' long rotary dryers, ¾" shell, 4' dia. center tubes. Excellent condition

FILTERS—CENTRIFUGALS

1—Niagara #510-28, 510 sq. ft. vert. leaf, T316 SS, ASME.
1—Alco 110 sq. ft., T316 vert. filter.
1—Niagara #60-30 T304 SS filter.
1—Niagara #53-36 T304 SS filter.
1—Elmco 18" dia. x 24" face T304 SS rotary vacuum.
2—Oliver 5'3" dia. x 3' face rot. vac., pressure precoat, T316 SS, ASME 30# pressure housing.
1—Oliver 5'3" dia. x 8' face, rot. vac., precoat, steel; UNUSED.
39—Sharples #AS-16V super cent. Inconel, Vapor-tite, 3 HP, sludge disch.
2—Sharples #16P, T304 SS pressure-tite.
5—Sharples #C-20, C-27 Super-D-Hydrators, T316 SS.
1—Bird 32" x 50" horiz. cent., T316 SS.
2—Sperry 30" P. & F. filter presses, 19-9 st. st. (NI-RESIST).

HEAT EXCHANGERS—CONDENSERS

1—1960 sq. ft. T316 SS exchanger, ASME.
1—1450 sq. ft. T316 SS vert. condenser.
7—800 sq. ft. T316 SS vert. condensers.
5—400 sq. ft. T316 SS vert. condensers.
50—T316 SS condensers & exchangers: 735, 427, 300, 264, 250, 235, 200, 165, 150, 125, 110, 47, 30 sq. ft.
25—Copper & cupro-nickel exch. & cond.

LIQUIDATING

CRUSHING-GRINDING PLANT

MANCHESTER, CONN.

13—Abbe Eng. #1B pebble mills, 6' dia. x 8' long, buhrstone lined, 30 HP motors & drives.
2—Hardinge 7' x 36" conical mills.
1—Allis Chalmers 6' x 18' pebble mills.
1—Symons 3' short head cone crusher.
1—Buchanan 13" x 24" JAW CRUSHER.
3—Bucket elevators, up to 50' high.

SEND FOR CIRCULAR #360A

PERRY EQUIPMENT CORPORATION

1413-21 N. SIXTH ST. PHILADELPHIA 22, PA.

Phone POplar 3-3505

CIRCLE P ON READER SERVICE CARD

SELECTED EQUIPMENT
FROM THE NEW "FIRST FACTS"
Send for Your Copy

Louisville Steam Tube Dryer; Monel Contacts; 52" x 34'

2 Monel Reactors 2800 Gal with Turbine Agts.; Jktd. 175 #ASME.

14 S/S Pressure Tanks; 700 Gal.

Nickel Clad Reactor 7' x 11'6".

Struthers Wells Type 316 S/S Jacketed & Agt. Reactors, 2000 Gal; All Sizes in Stock.

9 Devine Vacuum Chamber Shelf Dryers from Lab. Size to No. 36.

Struthers Wells Stainless Steel Drum Dryers; 5' x 10'; 5' x 4'.

Sweetland Filters No. 2 to No. 12.

Oliver Continuous Rotary Filters, & Feinc Rotary Vac Filters.

Sparkler Stainless Filter; 560 sq. ft.

Shriver, Sperry etc. Filter Presses, Cast Iron, Ni Resist, S/S etc. from 7" to 54".

Stainless Nutsche Filter 6' x 2'.

Fletcher and Tolhurst Centrifugals, S/S Rubber Cov.; Monel to 60".

Bird Continuous Hor. Conical Centrifuges, 24" x 38".

Fitzpatrick S/S Comminutators.

Mikro Pulverizers; Bantam to No. 4's.

Williams Hammer Mills; up to 200 HP.

Raymond Imp Mills; All Models, usually in Stock.

American Ring Roll Crusher; 50 HP.

Abbe Ball & Pebble Mills; all sizes.

Farrel-Birmingham Rubber & Plastic Mills, 14" x 30", 16" x 42", 18" x 42", 22" x 60".

2 Adamson Vulcanizers; 16' long Extruders NRM, Royle, Allen.

Brand NEW Falcon Double Ribbon Blenders in Stainless or Mild Steel; All Sizes. Always in stock.

Heat Exchangers and Condensers in Stainless, Monel, Nickel, Karbate.

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STerling 8-4672

CIRCLE Q ON READER SERVICE CARD

Chemical Manufacturing And Handling Equipment
FOR SALE

Boiler, ECLIPSE Scotch Marine, 50 HP, 145#, gas or oil, used 6 months

Gas Converter, GENERAL ELECTRIC, G5, 4000 CFH, 400°F., 125#

Lectrodryer, PITTSBURGH Size 750, Type BWC, 100# W.P.

Drycolene Producer, GENERAL ELECTRIC, 2000°, 200 cu. ft., Type G2

Impregnator, 21" diameter, 11" deep, combination impeller and spinner

Screen Vibrator, J. H. DAY, 50" x 116"

Hammermill, swing hammer type, 4½" x 16" opening, 25 HP

Hammermill, swing hammer type DIXIE, 24" x 40" opening, 25 HP

Hammermill, McKAIN, 12" x 12" opening, 5 HP

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GELB

PROCESSING EQUIPMENT

8—Western States 40" type 316 SS suspended type centrifuges complete with perforated baskets, plows and 40 HP motors. Year Built 1953.

1—Raymond 4 roll high side mill with 6' double whizzer, complete

1—Struthers Wells SS 1000 gal. jacketed reactor, complete with impeller type agitator and drive, 50 psi jacket, 15 psi internal pressure

1—Pfaudler Series R 60 500 gal. glass lined jacketed reactor complete with impeller type agitator, baffle and drive, 75 psi jacket, 25 psi internal

AUTOCLAVES, KETTLES AND REACTORS

2—Pfaudler 200 gal. glass lined jacketed reactors, complete with anchor type agitators and drives
1—Pfaudler Series P glass lined 30 gal. jacketed kettle, complete with anchor type agitator and drive, 90# jacket, 30# internal
1—Struthers Wells type 316 SS jacketed reactor, 2000 gal. complete with agitator and drive
1—Struthers Wells type 316 SS 400 gal., reactor with coils and turbine type agitator and drive, 250# coils
2—Pfaudler 300 gal. SS jacketed kettles, 76 psi jacket, 75 psi internal
1—Van Aist 250 gal. SS jacketed kettle complete with SS column and condenser
1—Pfaudler 200 gal. type 316 SS jacketed reactor, 75 psi jacket, 20 psi internal
2—Monel 2500 gal. jacketed autoclaves, 175# jacket, 175# internal
1—Autoclave Engineers type 316 SS autoclave, 1 gal. complete with motor, drive and coils, 1200# working pressure
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1—18,000 gal. aluminum storage tank

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1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
2—Louisville rotary dryers, 8' x 50', SS
1—Buflovak SS jacketed rotary vacuum dryer, 3' x 15'
3—Buflovak steel jacketed rotary dryers, 3' x 15', 5' x 20', 5' x 35'
1—Traylor 4' x 40' rotary dryer
1—Rotary dryer 6' x 36'
1—Western Precipitation Corp. SS pilot plant spray dryer, Type N-2
1—Bowen SS pilot plant spray dryer

FILTERS

3—Dorrco rubber covered filters, 6' x 2'
12—Sweetland #12 filters with 72 SS leaves
1—Niagara SS filter, Model 510-28
1—Oliver SS rotary pressure precoat filter, 5'3" x 8'
1—Oliver type 316 SS rotary vacuum filter, 4' x 5'
1—Oliver horizontal filter, 3'
1—GATX SS pilot plant filter, 2' x 6"
10—Shriver plate and frame filter presses, 12" to 42"
1—Shriver aluminum 30" x 30" P&F filter press, 30 chambers



THE GELB GIRL—JUNE 1960

CENTRIFUGES

1—AT&M 48" SS suspended type centrifuge, complete with plow, motor and imperforate basket
1—Fletcher 48" center slung SS centrifuge, complete with perforate basket and motor
4—Tolhurst 40" center slung rubber covered centrifuges, with perforate baskets and motors
2—Fletcher 40" center slung rubber covered centrifuges with perforate baskets and motors

MIXERS

2—Sturtevant #7 dustite rotary batch blenders, NEW
15—Robinson type 304 SS horizontal blenders, 255 cu. ft.
1—Richmond Engineering type 316 SS 40 cu. ft. horiz. double ribbon blender
1—Baker Perkins Size 20, 2000 gal. double arm jacketed vacuum mixer with double naben blades
1—Baker Perkins Size 16, Type UUEM, 150 gal. jacketed double arm dispersion type mixer, complete with compression cover and 100 HP motor.
2—Baker Perkins 20 gal. SS jacketed vacuum double arm mixers
1—Banbury #1 mixer, chrome plate rotor, with 50 HP motor
1—Stokes SS granulating mixer, Model 21 J
1—Entoleter impact mill type PPM-27

MISCELLANEOUS

1—Vulcan SS bubble cap column, 4' x 25' plates
1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
1—Badger type 316 SS bubble cap column, 36" dia. x 8 trays
1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
1—Condenser Service type 316 SS heat exchanger, 350 sq. ft.
3—Badger type 316 SS heat exchangers, 500 sq. ft. and 600 sq. ft.
10—Davis Engineering SS heat exchangers, 145 sq. ft., NEW
4—Davis Engineering Corp. 20, 125 sq. ft. heat exchangers, NEW
1—Downington type 316 SS heat exchanger, 750 sq. ft.
1—Mikro Model 1SH pulverizer
2—Swenson type 316 SS vacuum crystallizer, 3'6" x 12', 2' x 12'
3—Williams type 316 SS hammermills, Model AK
1—Sprout Waldron Model 501-D pelleter
1—Ross 6" x 14" 3 roll paint mill, complete
1—Fitzpatrick SS comminuting machine with 3 HP motor

1—Bird SS centrifugal filter 18" x 28" with 15 HP motor

1—Pfaudler Series R 300 gal. glass lined jacketed reactor complete with impeller type agitator, baffle and drive, 90 psi jacket, 25 psi internal, NEW

1—Pfaudler Series P 20 gal. glass lined jacketed reactor complete with impeller type agitator, baffle and variable speed drive, 100 psi jacket, 30 psi internal

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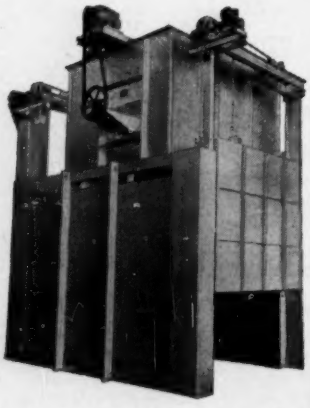
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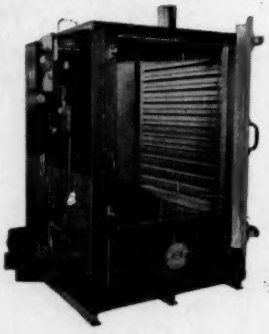
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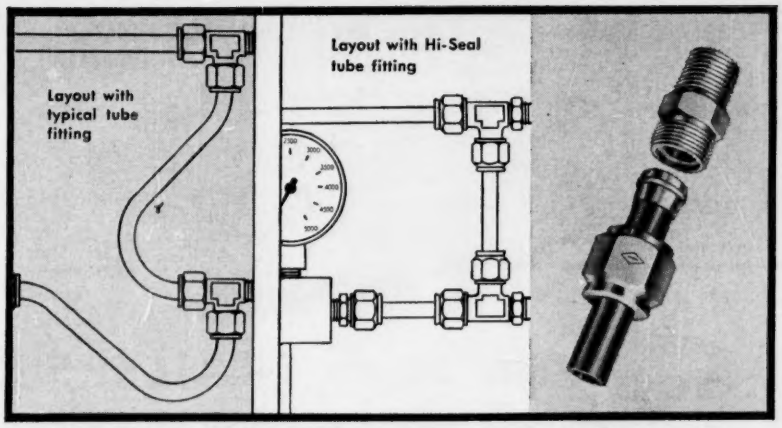
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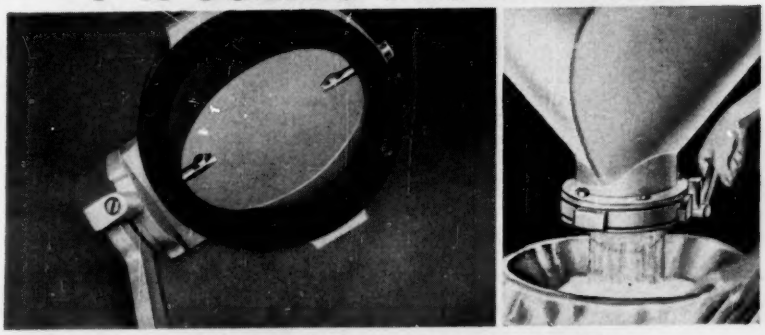
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27-60

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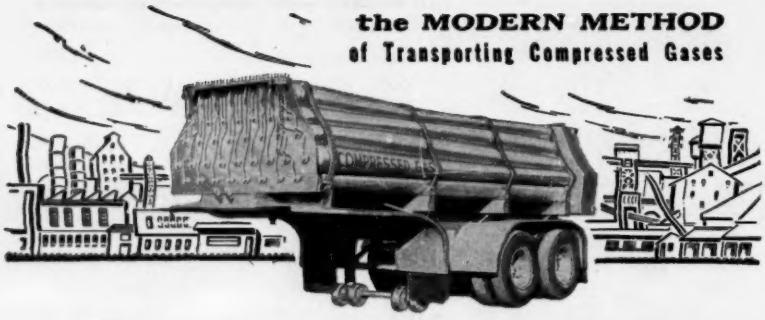
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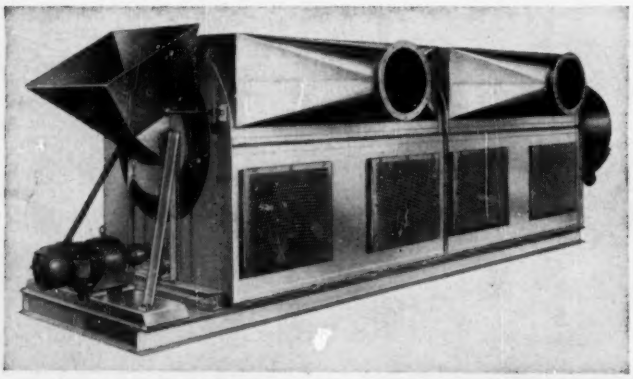
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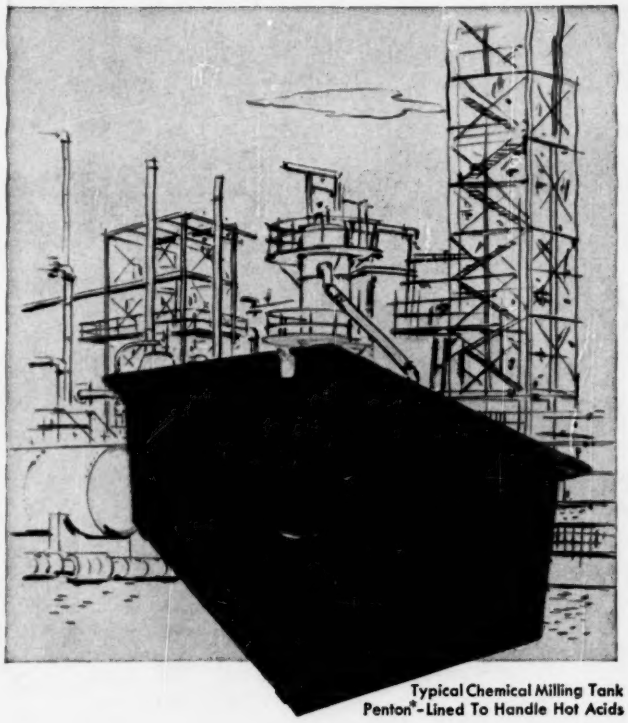
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for Corrosion Resistant Service



Typical Chemical Milling Tank
Penton®-Lined To Handle Hot Acids

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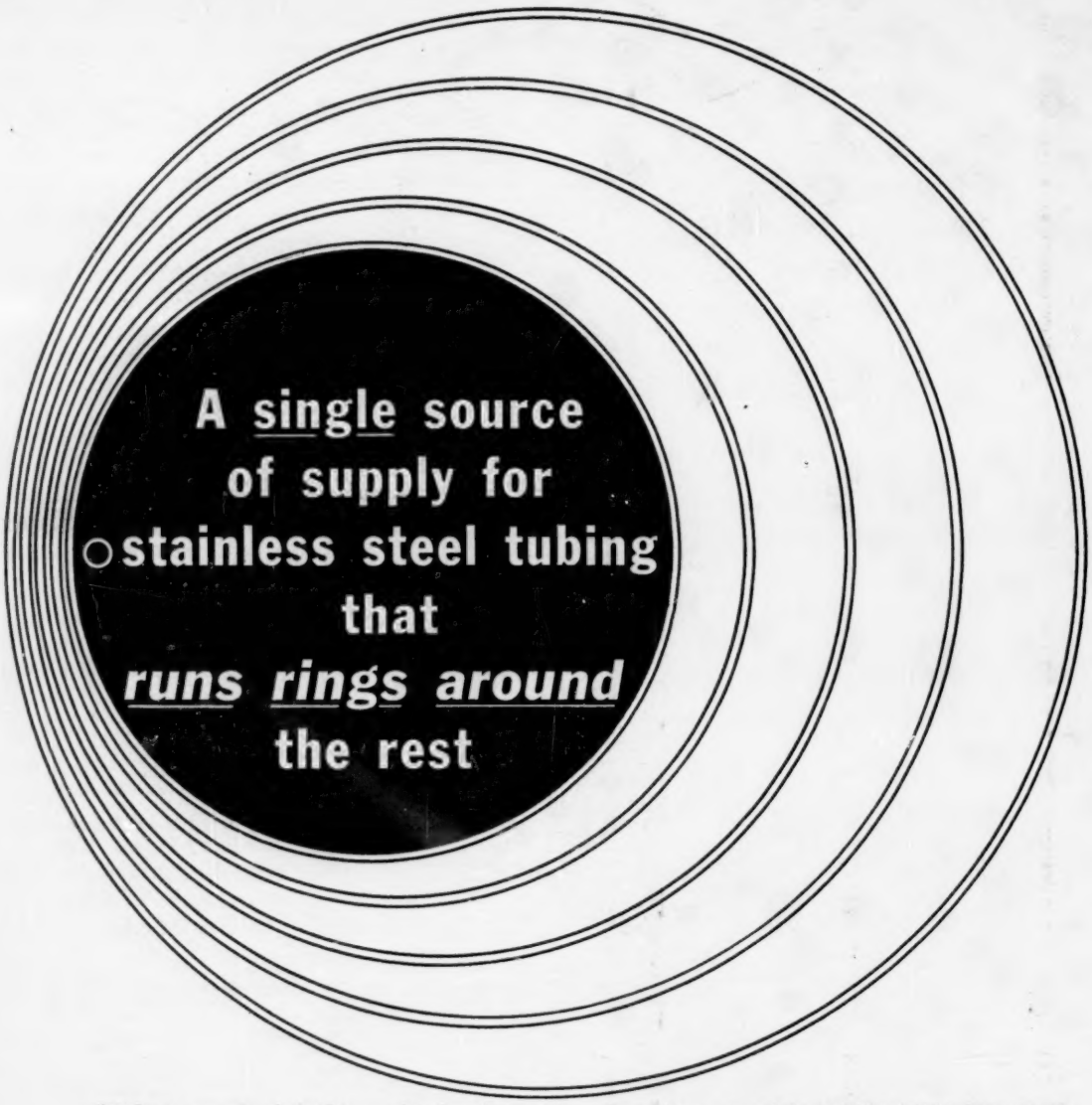
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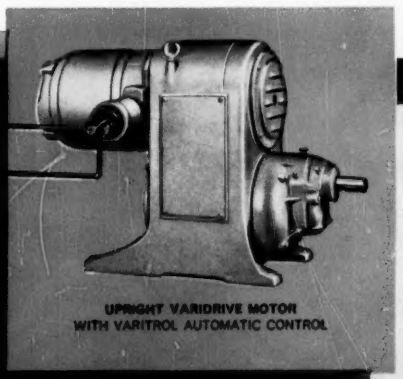
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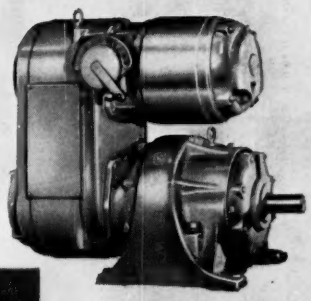
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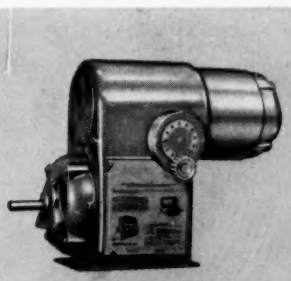
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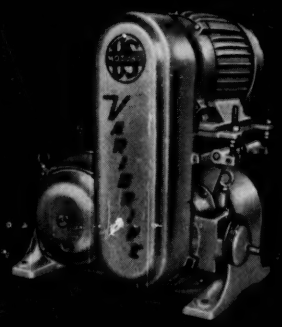


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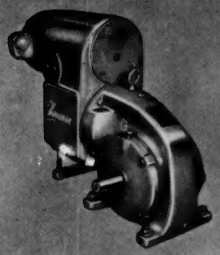


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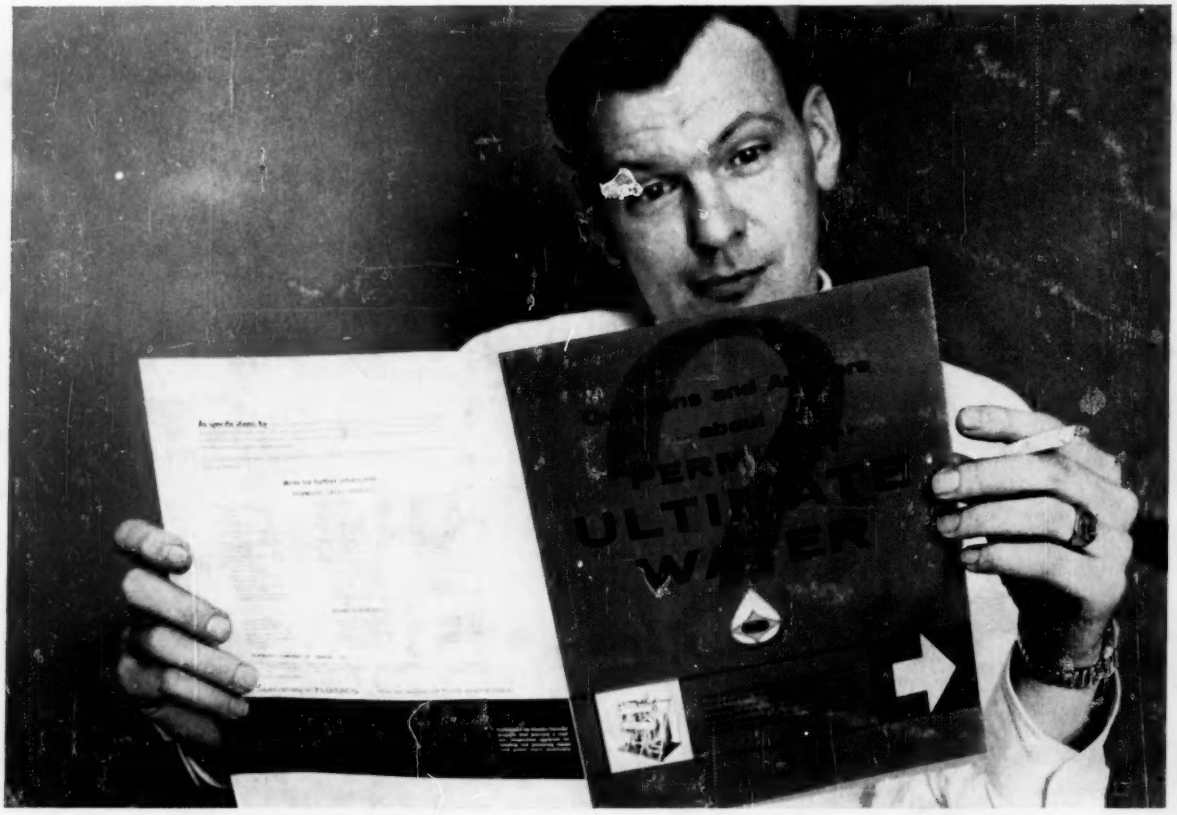


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